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PREPARED FOR:

City of Rock Island
U.S. EPA
U.S. DOJ

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Preliminary Screening Summary of Control Technologies and Alternatives

City of Rock Island, Illinois CSO Long Term Control Plan

To satisfy Item No. 13 Appendix B of the consent decree entered into the United States District Court for the central district of Illinois in the matter of U.S. V. City of Rock Island, Illinois, et al., Civil Action No. 4:00-CF-04076

Symbiont
Project No. W041106.BG500

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Section 1.0
INTRODUCTION

The City of Rock Island (the City) is required by the United States Environmental Protection Agency (EPA) to prepare a Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP) consistent with the requirements of the Consent Decree entered into the United States District Court for the Central District of Illinois in the matter of U.S. v. City of Rock Island, Illinois, et al., Civil Action Number 4:00-CV-04076. This Preliminary Screening Summary of Control Technologies is part of the LTCP and satisfies section 5(c) of Appendix A of the Consent Decree.

Section 5(c) of Appendix A of the Consent Decree mandates the identification and preliminary screening of an appropriate range of technologies for eliminating, reducing, or treating CSO discharges, including an evaluation of varying levels of control for each alternative that will reduce the number of untreated CSOs down to a range of overflows per year.

Section 2.0
GOALS AND OBJECTIVES

The evaluation of CSO control is a critical element of long-term planning. As such, goals and objectives must be established and both preliminary and detailed analysis must be performed before a recommended plan can be established. This memo addresses the preliminary portion of the analysis

The key objectives of the proposed CSO control projects are to

1) bring and keep the City in full compliance with the terms and conditions of their NPDES Permit,

2) meet the objectives of USEPA's April 19, 1994, Combined Sewer Overflow Policy and the Clean Water Act,

3) satisfy the requirements of the Consent Decree.

To accomplish these objectives the City has set two main goals: (1) eliminate or relocate outfalls to sensitive areas and (2) meet the USEPA CSO Policy's Presumption Approach. These are both discussed in more detail below.

2.1 OUTFALL ELIMINATION/RELOCATION

The City has identified five of the eight existing combined sewer outfalls for elimination or relocation based on their location in sensitive areas. The City intends to leave three outfalls at their current locations. Table 2-1 lists the City's intention for each CSO outfall location as was indicated in the *Outfall Elimination or Relocation Technical Memorandum*.

Table 2-1
OUTFALL ELIMINATION OR RELOCATION
SUMMARY OF INTENTIONS

Outfall	Location	Intent
001/001A	Mississippi River at WWTP (also carries WWTP effluent and stormwater)	Outfall to remain. Wet weather treatment options evaluated.
003	Mississippi River at 21st Street	Outfall to be eliminated or relocated downstream of Sylvan Slough.
004	Mississippi River at 23rd Street	Outfall to be eliminated or relocated downstream of Sylvan Slough.
005	Mississippi River at 24th Street (Centennial Bridge)	Outfall to be eliminated or relocated downstream of Sylvan Slough.
006	Mississippi River at 25th Street	Outfall to be eliminated or relocated downstream of Sylvan Slough.
007	Blackhawk Creek in Blackhawk State Park	Outfall to be eliminated or relocated downstream of Black Hawk State Park.

Table 2-1 OUTFALL ELIMINATION OR RELOCATION SUMMARY OF INTENTIONS		
Outfall	**Location**	**Intent**
011	Blackhawk Creek (west branch) at 31st Avenue	Outfall to remain.
012	Blackhawk Creek (east branch) at 28th Avenue	Outfall to remain.

2.2 LTCP APPROACH

To meet regulatory requirements and the goals described above, the City must comply with USEPA and Illinois Environmental Protection Agency (IEPA) CSO policies.

2.2.1 USEPA CSO Policy

According to the USEPA's CSO Policy, there are two approaches for achieving compliance: the Demonstration Approach and the Presumption Approach. The City of Rock Island has decided to use the Presumption Approach.

The first means of compliance with the USEPA, the Demonstration Approach, requires demonstrating that the incremental impact of CSO discharge does not cause water quality violations. The demonstration approach requires development of a comprehensive water quality model. Calibration of a water quality model would require long-term monitoring of Rock Island's receiving waters (the Mississippi and Rock Rivers and Black Hawk Creek) under various conditions, monitoring of CSO discharge, and potentially modeling other discharge sources to determine the impacts of existing and potential future discharges. This approach is impractical while maintaining the schedule stipulated by the Consent Decree. In addition, two of Rock Island's receiving waters, the Mississippi and Rock Rivers, do not consistently meet water quality standards before they reach Rock Island. Given the small volume of CSO discharge compared to the flow volume in each river, it would be difficult to 1) determine Rock Island's relative CSO impact on the failure to meet water quality standards and 2) set reasonable CSO reduction goals different from the presumption approach.

The second method, the Presumption Approach, recognizes that a minimum level of control will likely be effective in meeting water quality objectives. The CSO Policy requires that long-term planning consider at least one alternative that would meet the Presumption Approach. Under the Presumption Approach, adopted CSO controls must meet one of the following criteria (59 *Federal Register* 18688 II.C.4.a):

1. No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflows per year, or

2. Elimination or capture of no less than 85% by volume of the combined sewage collected in the Combined Sewer System during precipitation events on a system-wide annual average basis, or

3. Elimination or removal of no less than the mass of pollutants identified as causing water quality impairment through sewer characterization, monitoring, and modeling effort for the volumes that would be eliminated or captured for treatment under Criterion 2 above.

The City has chosen to use criteria No. 1 to meet the Presumption Approach. The presumption approach requires the equivalent of primary treatment and disinfection for wet weather flow exceeding secondary treatment capacity while also allowing an annual average of four and maximum of six untreated CSO events. This approach recognizes that unmet water quality objectives caused by CSO discharge shall be addressed.

2.2.2 State of Illinois Policies

Combined sewer overflows (CSOs) in Rock Island, Illinois, are subject to a number of rules in the State of Illinois administrative code. Two of the requirements included in the rules state that

1) the first flush must receive full secondary treatment (35 Ill. Adm. Code 375.102), and

2) additional flows, up to ten times the average dry weather flow for the design year, must receive a minimum of primary treatment and disinfection with adequate retention time (35 Ill. Adm. Code 306.305).

Pursuant to a joint Rock Island/Illinois Environmental Protection Agency (IEPA) petition, the Illinois Pollution Control Board granted an exemption to these requirements for Rock Island CSOs 001, 003, 004, 005, and 006. The exemption does not apply to CSOs 007, 011, and 012.

Section 3.0
ALTERNATIVE EVALUATION CRITERIA

Rock Island's alternative evaluation is focusing on achieving the objectives and goals discussed above. Several assumptions were necessary to evaluate the likely effectiveness of the proposed control technologies. Using these assumptions, the preliminary analysis was performed. Detailed analysis of the alternatives will be undertaken using the same assumptions. Below is a discussion of the assumptions made, evaluation process followed, and screening criteria used to arrive at the final alternatives for detailed analysis.

3.1 DESIGN CRITERIA FOR ALTERNATIVE IDENTIFICATION

Three major assumptions were made in order to develop and analyze CSO remediation alternatives:

1. 24 hr CSO interevent period
2. increased pumping capacity at WWTP headworks
3. use of a 10-year storm for collection system conveyance capacity evaluation
4. need to address flooding problem at 40th Street & 5th Avenue

Assumption 1 is discussed in detail in the Appendix. Assumption 2 recognizes that the pumping capacity at the WWTP headworks will be increased as required for the chosen alternative.

The 10-year, 1-hour storm event assumption for collection system conveyance capacity analysis is consistent with the City's current design standards and the existing collection system's capacity. The City's current design standard for newly constructed storm water drainage from residential and commercial streets is the 10-year, 24-hour storm, and design standards for past construction of the existing combined sewer system has been evaluated and found to range from a 9-month to a 5-year event. Results from the 10-year storm analysis were used along with the 56-years of record to size the high rate treatment equipment at the Mill Street Wastewater Treatment Plant to meet the presumption approach requirement of an average of 4, maximum of 6 overflow events per year.

A local flooding problem exists at the 40th Street and 5th Avenue intersection. The city would like to address this flooding issue under the LTCP, and thus a 1.7 MG storage tank at this intersection is included with all alternatives.

3.2 ALTERNATIVE IDENTIFICATION

LTCP alternatives were developed both from control technologies specified in the Consent Decree and from other technologies identified by the City. These technologies include

- no action,
- partial separation,
- storm water source removal,
- storage/equalization basins,

- new intercepting sewer,
- relief sewers,
- high rate primary treatment,
- full separation,
- and river infiltration removal.

The control technologies were combined to form eight alternatives, each of which can meet the City's goals. Topography, land use, existing sewer system configuration, and feasibility were among the factors used to choose specific control technologies to solve individual problems. The City's sewer system is divided into two large sewersheds, the northside and the southside. These sewersheds combine at the WWTP. Because of their isolation from each other, the northside and southside were evaluated independently. Four alternatives were developed for the northside and four for the southside:

NORTHSIDE
Alternative 1 – Source Control
Alternative 2 – Increased Conveyance to WWTP Along Existing Interceptor Route
Alternative 3 – New Relief Sewer Along 6th Ave.
Alternative 4 – Consolidation of CSOs 003-006 West of Centennial Bridge

SOUTHSIDE
Alternative 5 – Source Control
Alternative 6 – Relocation of CSO 007
Alternative 7 – Increased Conveyance to WWTP
Alternative 8 – Increased Diversion at Saukie and Franciscan Treatment Facilities

3.3 EVALUATION PROCESS

The preliminary analysis and screening of alternatives used a three step process. First, the City analyzed the conveyance control technologies individually to determine how well they each could achieve the goals described above (Section 4.0). Second, the City analyzed the treatment control technologies to understand the capabilities of the available technologies (Section 5.0). Finally, the City combined individual conveyance and treatment control technologies to create potential assembled conveyance alternatives for the northside and southside that would all meet the goals described above. These preliminary assembled alternatives were analyzed according to the screening criteria below to select three to four final alternatives for detailed alternative evaluation for both the north and south sides (Section 6.0).

3.4 SCREENING CRITERIA

The City developed the screening/evaluation criteria shown in Table 3-1. The screening criteria were identified to ensure that an objective comparison of alternatives could be made and that the major concerns of the citizens of Rock Island and the EPA would be accounted for during alternative evaluation. The preliminary assembled alternatives were analyzed and selected (for detailed screening) or eliminated according to the criteria shown in this table. Considering that all of the preliminary assembled alternatives were designed to meet the outfall elimination/relocation and presumption approach goals, construction cost was a significant factor as to whether an alternative should be retained for detailed evaluation or be eliminated from further consideration. For the northside, all alternatives with costs within 15% of the lowest cost alternative were retained for detailed evaluation. This is consistent with USEPA facilities planning guidance for the evaluation of cost effectiveness. The remaining alternatives were further evaluated subjectively using the criteria in Table 3-1 to determine if they should be retained. Since the lowest cost alternative on the southside was less than half the cost of the next lowest cost alternative, cost was not considered as uniformly for the selection of alternatives on the southside.

Table 3-1 Screening/Evaluation Criteria

Cost Construction O& M	***Socioeconomic Impacts*** Construction disruption (business, etc) Landuse compatibility Aesthetics Parks/Recreation Property requirements/acquisition Historic Archaeologic Resources
Constructability Space Geotech Impact to other facilities Local construction capabilities	
Operations Reliability and Redundancy Compatible with existing system(s) Staffing Energy usage Chemical usage	***Environmental Impacts*** Water Quality Wetlands Aquatic Habitat Hydrology Air Quality Threatened and Endangered Species

The screening/evaluation criteria shown in Table 3-1 will be used in greater depth during the detailed alternatives evaluation.

Section 4.0
CONVEYANCE CONTROL ALTERNATIVE IDENTIFICATION AND SCREENING

As stated in the Consent Decree, the preliminary screening summary should consider and summarize various conveyance-related technologies, including

- no action,
- partial separation,
- storm water source removal,
- storage/equalization basins,
- new intercepting sewer,
- relief sewers,
- and high rate primary treatment.

In addition to the ones specifically called for in the Consent Decree, the City chose to consider two additional conveyance related control technologies:

- full separation
- river infiltration removal

4.1 SUMMARY AND APPLICABILITY OF CONVEYANCE CONTROL TECHNOLOGIES

Because of the characteristics of Rock Island's wastewater collection and treatment system, not all technologies are applicable to all locations. For example, partial separation is only applicable to portions of the sewer system that are still fully combined. Table 4-1 summarizes potential applications of individual conveyance-related control technologies.

Table 4-1
Potential Applications of Collection-Related Control Technologies

Control Technology	Discussion
No action	The no action control technology represents maintaining, without change, current CSO control facilities. The no action alternative includes continued operation and maintenance of the partially separated areas, the Saukie and Franciscan Storage/ Treatment facilities, the expanded Black Hawk lift station, and the fixed weirs located at the North and South Diversion Structures.

Table 4-1	
Potential Applications of Collection-Related Control Technologies	
Control Technology	**Discussion**
Partial separation	This technology can be applied to the remaining fully combined portions of the Rock Island wastewater collection system. These combined areas are tributary to CSOs 003-006. The potential application area is highlighted below. Partial separation would involve installing a storm sewer system and disconnecting all public sources of direct inflow such as street inlets. Private sources, such as parking lot area drains would also be disconnected where feasible. The partial separation effort would be similar to Rock Island's CSO control program conducted during the 1970s and 80s in other areas of the City. As such, it would be expected to have a similar range of effectiveness. The monitoring program, documented in the *Collection System Hydraulic Model Technical Memorandum*, found the fully combined area captures, on an average, 19 to 27% of the rainfall during a rainfall event. Partially separated areas capture an average of 2 to 3.8% of the rainfall. For the evaluation of this control technology, it is assumed that future partial separation efforts would have a similar range of effectiveness. 

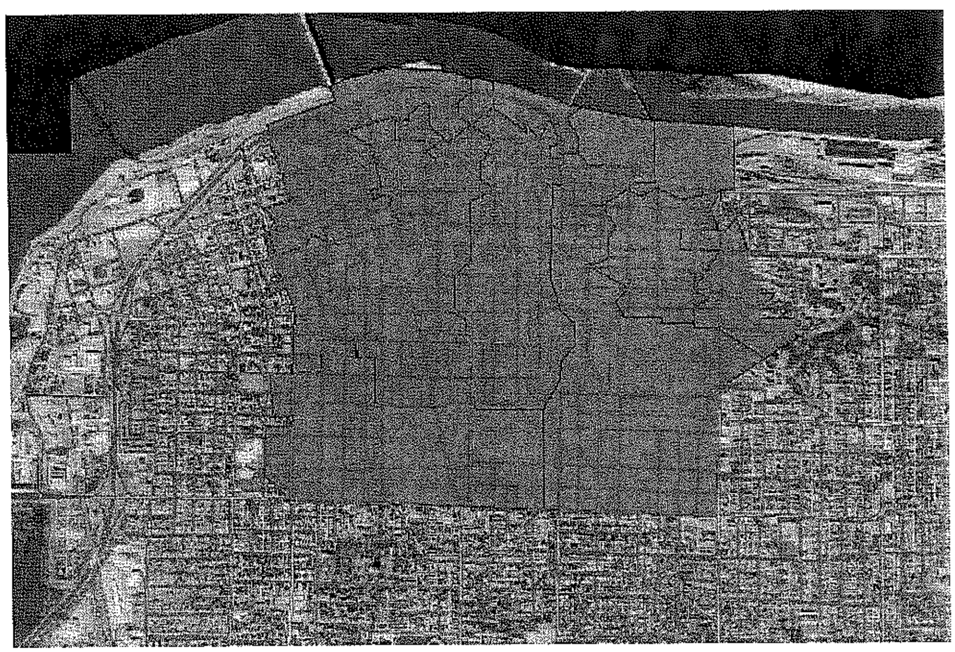
Table 4-1	
Potential Applications of Collection-Related Control Technologies	
Control Technology	**Discussion**
Full separation	This technology can be applied to the remaining fully combined portions of the Rock Island wastewater collection system. These combined areas are tributary to CSOs 003-006. The potential application area is highlighted below. Full separation would involve installing a sanitary system and necessary private lateral connections. The existing combined system would become a storm water drainage system, discharging at existing CSO outfalls. This control technology requires replumbing any building that has connected downspouts or foundation drains. Portions of the system on the south slope where sewers were constructed as separate sewers and foundation drains were not tied to the sanitary sewer system capture an average of 1.4% of the rainfall. It is assumed that full separation efforts would produce runoff volumes similar to these originally separate areas. 

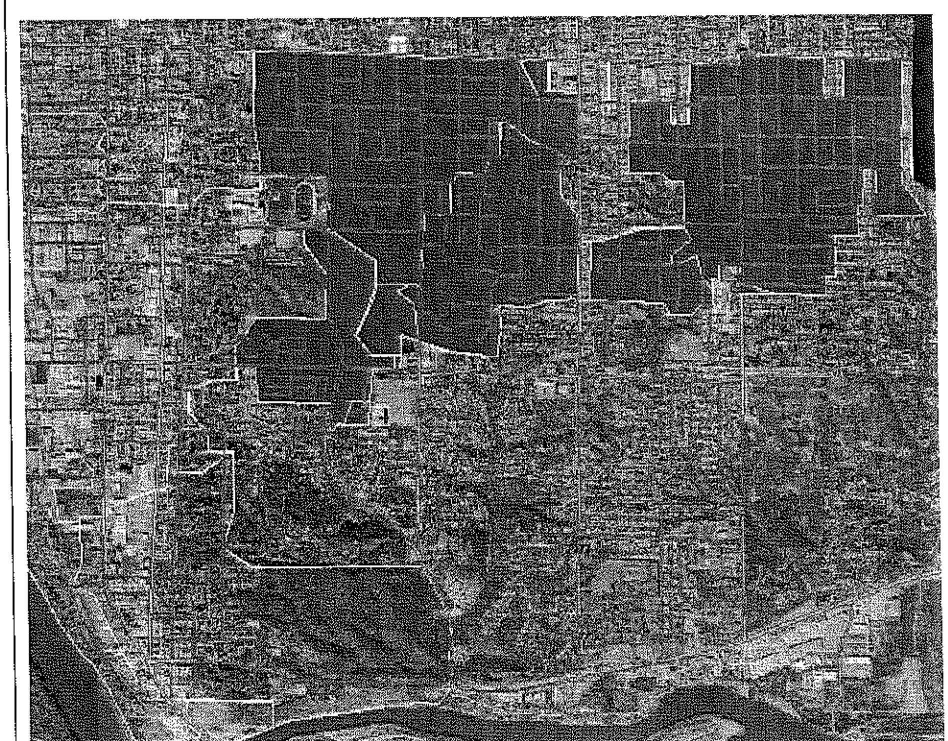
Table 4-1	
Potential Applications of Collection-Related Control Technologies	
Control Technology	**Discussion**
Stormwater (clearwater) source removal	This technology would be applied to the partially separated areas of the city where the monitoring program has identified high infiltration and inflow volumes. The potential application area is highlighted below. Rock Island attributes the high rate of I/I in this area to the lack of an installed storm sewer system (rainfall runoff is conveyed overland), flat topography, and the prevalence of connected foundation drains. Removing stormwater sources would involve extending the storm sewer system to unserved streets and disconnecting all foundation drains. The monitoring program, documented in the *Collection System Hydraulic Model Technical Memorandum*, found these service areas capture, on an average, 10 to 20% of the rainfall during a rainfall event. Other partially separated areas located on the south slope capture an average of 2% of the rainfall. It is assumed that stormwater (clearwater) source removal efforts for the illustrated sewer areas would produce runoff volumes similar to the other partially separated areas. 

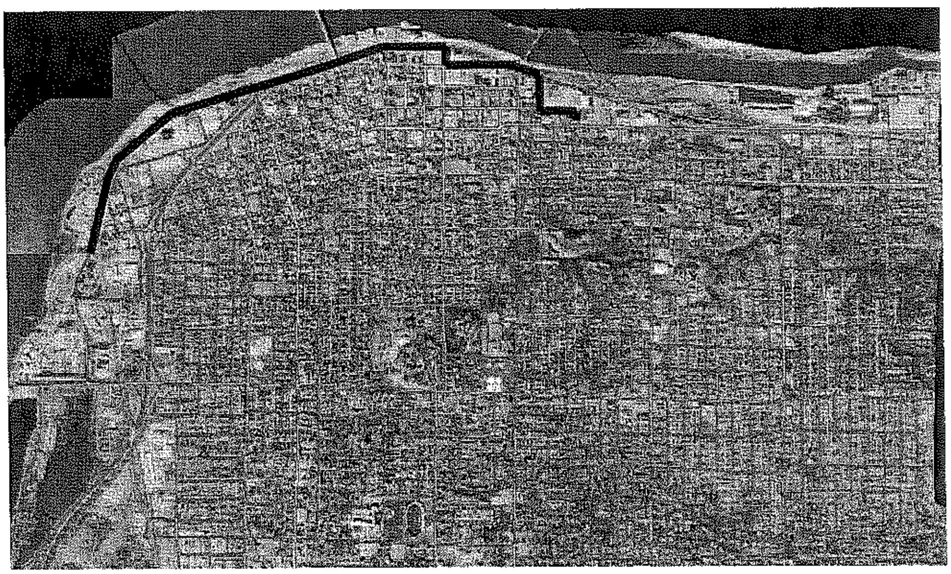
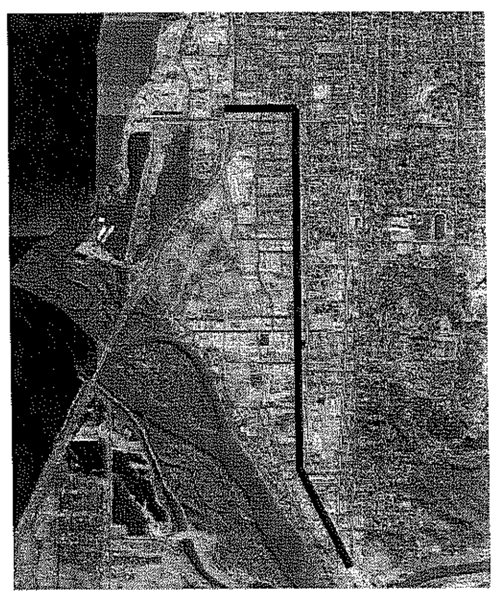
Table 4-1	
Potential Applications of Collection-Related Control Technologies	
Control Technology	**Discussion**
New intercepting sewers	This technology involves installing parallel or replacement interceptors to augment the capacity of the existing interceptors to convey water to the Mill Street WWTP. Interceptors would be sized to convey the expected 10-year peak discharge rate. The new Northside interceptor would range in size from 90 to 120 inches in diameter. The new Southside interceptor would range in size from 48 to 66 inches, depending upon designed depth and slope.  

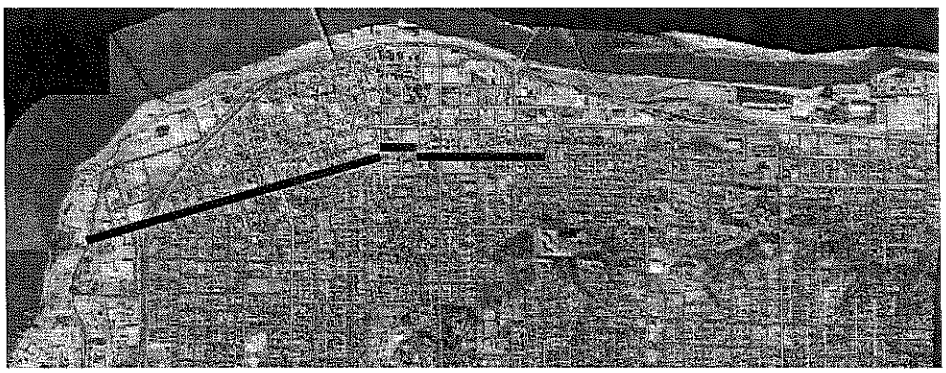
Table 4-1	
Potential Applications of Collection-Related Control Technologies	
Control Technology	**Discussion**
Relief sewers	This technology involves installing relief sewers to divert water upstream of the interceptors and convey sewage to the Mill Street WWTP along an alternate route. There are two potential routes for relief sewers, one to relieve the north side, one to relieve the south side. Relief sewers would be sized to convey the expected 10-year peak discharge rate. The 6th Avenue relief sewer would have a diameter of 60 inches and discharge to the existing interceptor (which has sufficient capacity to convey this additional flow). The south side relief sewer that would pick-up extra flow that bypasses the Saukie and Franciscan storage/ treatment tanks would have a diameter of 18-20 inches. The south side relief sewer would need to be constructed as a force main. It would require two pump stations.  

Table 4-1	
Potential Applications of Collection-Related Control Technologies	
Control Technology	**Discussion**
Removal of River Infiltration	This technology can be investigated in the portion of the City's sewer system installed below peak flood stage, with priority given to sewers that are deeper and closer to the river. Removal of river infiltration during elevated river stage requires discovering infiltration and inflow locations and then repairing them. Specific sources are currently unknown, but the repairs could involve grouting or replacing combined or sanitary sewers; rehabilitating manholes, improving seals on flood gates; and disconnecting foundations drains in the combined sewer service area. For initial screening purposes, the City assumed that it could remove all river infiltration. Removing river infiltration has negligible effect on CSOs 003, 004, 005, 006, 007, 011, and 012. Almost all the tributary area to these CSOs lies outside of the river's zone of influence. Benefits are limited to reduced volume and frequency of overflows at CSO 001.
High Rate Primary Treatment	Although technically a treatment control technology, this option was considered under conveyance technologies for the existing high rate treatment tanks on the southside of the city because it reduces flows at the Black Hawk Lift Station. Expanding the primary treatment and disinfection capabilities of the existing tanks would significantly reduce the flow in the sewers downstream of the tanks and thus reduce or eliminate overflows at CSO 007. The maximum potential capacity increase, based on upstream sewer conveyance capacity, is distributed as follows **Outfall** — **Maximum Expansion Capacity** 011 — 15 MGD 012 — 10 MGD Specific technologies for achieving high rate primary treatment at these and the other outfalls is discussed in the treatment control technologies section.

4.2 EVALUATION OF CONVEYANCE CONTROL TECHNOLOGIES

Each of the above technologies was analyzed to determine its effectiveness at every applicable outfall using the SWMM model. The analysis results are summarized in Table 4-2.

Technology	System Wide	Southside	
	1	11	12
No Action	26 MG CSO Volume for 10-yr 6hr storm 158 MGD Peak CSO Rate for 10-yr 6hr storm Average Overflows: 17/yr Maximum Overflows: 28/yr Max. Overflow Rate: 355 MGD (Max Duration = 828 hrs)	0.9 MG CSO Volume for 10-yr 6hr storm Average Overflows: 3/yr Maximum Overflows: 9/yr Max. Overflow Rate: 4 MGD	1.1 MG CSO Volume for 10-yr 6hr storm Average Overflows: 3/yr Maximum Overflows: 9/yr Max. Overflow Rate: 4 MGD
Partial Separation	60% Reduction in CSO Volume for 10-yr 6hr storm 57% Reduction in Peak CSO Rate for 10-yr 6hr storm Average Overflows: 7/yr Maximum Overflows: 14/yr Max. Overflow Rate: 164 MGD	N/A	N/A
Full Separation	[illegible] Reduction in CSO Volume for 10-yr 6hr storm [illegible] Reduction in Peak CSO Rate for 10-yr 6hr storm Average Overflows: [illegible] Maximum Overflows: [illegible] Max. Overflow Rate: [illegible] MGD	N/A	N/A
Removal of Storm Water Sources to Match Runoff Rates in Southwest Side Partially Separated Areas (Meters 21 and 22) (runoff/rainfall reduced from 12-20% to 1.9%)	Average Overflows: 15/yr Maximum Overflows: 26/yr Max. Overflow Rate: 350 MGD	92% Reduction in CSO Volume for 10-yr storm Average Overflows: 0.04/yr Maximum Overflows: 1/yr Max. Overflow Rate: 2 MGD	90% Reduction in CSO Volume for 10-yr storm Average Overflows: 0/yr Maximum Overflows: 0/yr Max. Overflow Rate: 0 MGD
Remove River Inflow	Average Overflows: 17/yr Maximum Overflows: 26/yr Max. Overflow Rate: 355 MGD (Max Duration = 65 hrs)	N/A	N/A
Storage/EQ Tanks	Volume of 10-year 6hr Storm Overflow = 26 MG EPA Required Volume = [illegible] MG Zero Overflows Volume = [illegible] MG	N/A	N/A
High Rate Primary Treatment	EPA Req. Primary = 100 MGD Zero Overflows Primary = 350 MGD	To reduce overflows at CSO 007, diversion to the storage/treatment tank must be increased to 15 MGD.	To reduce overflows at CSO 007, diversion to the storage/treatment tank must be increased to 10 MGD.
New Interceptor Sewers	N/A	N/A	N/A
New Relief Sewers	N/A	N/A	N/A

Solution to Overflows

4.2.1 Evaluation Method

The no action and source removal options were modeled using the long-term SWMM STORAGE/TREATMENT model and the 10-year, 6-hour storm in the detailed SWMM EXTRAN model. The STORAGE/TREATMENT model, using 56 years of recorded rainfall, provided an estimate of the annual average number of overflows and maximum expected number of overflows in a single year at each outfall for each technology. It also gave a maximum expected flow rate at each outfall. The 10-year, 6-hour storm in the EXTRAN model was used to determine how close each technology came to eliminating overflows. As mentioned above, if there was no overflow at an outfall for the 10-year storm, then the outfall was considered eliminated. If the outfall was not eliminated, the model indicated the flow volume and peak flow rate that remained. The river infiltration removal technology was only modeled using the STORAGE/TREATMENT model. This was because the amount of river infiltration is influenced by long-term river stage trends, not specific storm events.

The volume of storage or equalization tanks required for each outfall was also determined using the SWMM models. The overflow volumes obtained from the EXTRAN model for the 10-year, 6-hour storm for each outfall were determined as the storage volume required for overflow elimination. The STORAGE/TREATMENT model was run for different storage volumes to establish the volume necessary to meet the USEPA's Presumption Approach requirements (an average of four and a maximum of 6 overflows per year). The STORAGE/TREATMENT model was also used to determine the storage volume required to eliminate overflows. In comparison to the EXTRAN model numbers, the STORAGE/TREATMENT model indicated that a larger amount of storage was needed to eliminate the outfalls. This is because the STORAGE/TREATMENT model runs consecutive storm events where the sewage in the storage tank from one storm event might not be fully drained out before the next storm event occurs. Thus, the STORAGE/TREATMENT model numbers are considered more conservative and reliable than the EXTRAN model volume estimates.

New interceptor sewers were considered as a possible control technology for CSOs 003, 004, 005, 006 (the northside CSOs), and 007 as shown in Table 4-2. New sewer sizes were determined for installing parallel north, south, and BHLS interceptors based on flow rates obtained from the EXTRAN model for the 10-yr, 1-hr storm and the known pumping capacity at the BHLS. Relaying the interceptor sewers was not closely examined as it was assumed that the bypass pumping required to construct them would be extremely expensive. If this technology is selected for implementation, then further analysis will be performed to verify the most cost effective option, a sewer relay or a parallel sewer, for the City.

Also listed in Table 4-2 are new relief sewers proposed to convey excess northside and southside wet weather flows to the WWTP. The northside relief sewer was sized by modeling it in the EXTRAN model with the 10-year storm. The southside relief sewers were size based on upstream pipe capacity data.

4.2.2 Evaluation Results

Table 4-2 is shaded to indicate each technology's effectiveness at meeting LTCP goals for each outfall. In evaluating the effectiveness, outfalls are grouped as System-wide (CSO 001), Northside (CSOs 003, 004, 005, and 006), or Southside (CSOs 007, 011, 012). Further discussion focuses on these groups

To meet LTCP objectives, the System-wide outfall (CSO 001) must reduce overflows to the level required by the presumption approach. Only two conveyance control technologies were found to reach this objective independently: full separation and storage/equalization. Partial separation, removal of stormwater sources, and removal of river infiltration do not reduce wet weather flow sufficiently to achieve objectives.

To meet LTCP objectives, the Northside outfalls (CSOs 003, 004, 005, and 006) must be eliminated or relocated to outside of Sylvan Slough. Upgrading the Northside Interceptor (with a parallel interceptor sewer) and full separation achieve this objective. Storage of CSO flows also shows promise for reaching the objective. Partial separation eliminates overflows at CSO 006 and could form the basis of an approach to eliminate overflows at CSO 003 and 004. It does not, however, reduce wet weather flow sufficiently to eliminate overflows at CSO 005.

The three Southside outfalls discharge less frequently than required by the presumption approach. However, CSO 007 must be eliminated or relocated west of Black Hawk State Park (a sensitive area). Reducing the amount of wet weather flow arriving at CSO 007 from the sewersheds around the Saukie and Franciscan Storage/Treatment tanks significantly reduces or eliminates the CSO 007 overflow. There are three potential methods to achieve this wet weather flow reduction (as shown in the table):

- removing clear water sources by installing storm sewers and disconnecting foundation drains
- installing a relief sewer to convey water directly to the Mill Street WWTP
- increasing high rate wet weather treatment at the Saukie and Franciscan Storage/Treatment Tanks

Adding a storage basin upstream of CSO 007 also shows promise for eliminating the outfall. Increased interceptor capacity (upstream of and including the BHLS) could additionally be employed to either eliminate or relocate CSO 007.

From the analysis of control technologies, it was determined that no one control technology works for all outfalls. Alternatives must thus contain an assemblage of control technologies to achieve LTCP objectives. Each assembled alternative must contain a sufficient collection of control technologies to achieve LTCP objectives at all outfalls. Section 6.0 describes the development of preliminary assembled alternatives.

Section 5.0
TREATMENT CONTROL TECHNOLOGY EVALUATION AND SCREENING

As stated in the Consent Decree, the preliminary screening summary should consider and summarize various treatment-related technologies, including

- floatables removal technologies,
- high rate primary treatment technologies,
- disinfection technologies,
- and increased secondary treatment.

These technologies are described and evaluated below.

5.1 FINE SCREENING

Fine screens have been used successfully to effectively remove solid and floatable materials from wastewater flows. Fine screens normally have opening sizes of ¼ inch or less and can be stationary, rotating or mechanical step screens.

Stationary screens and mechanical step screens were evaluated for treating wet weather flows in Rock Island. These screens are summarized below.

5.1.1 Stationary Screens

Stationary screens designed for the removal of floatables and other solid materials from CSOs are either horizontal reciprocating screens or tangential flow screens. Horizontal reciprocating screens operate like an overflow weir and capture solids as the water in the channel rises and overflows through a weir-mounted screen. Solids and other materials are captured on the screen as the water overflows through the screen. These rigid screens usually consist of heavy-duty corrosion-resistant stainless steel bars with openings ranging from 4 to 10 mm (0.16 to 0.40 inch) that run horizontally across the length of the channel, parallel to the normal direction of flow. Once an overflow occurs, the screen functions as an emergency overflow weir by capturing solids and floatable materials. A hydraulically-driven rake assembly travels back and forth across the screen, removing solids caught on the screen. The solids and floatable materials captured by the screen are captured in the wastewater channel, which are carried back to the wastewater treatment plant (WWTP) with the normal wastewater flow.

A tangential flow screen relies on the natural motion of water to screen and trap solids in a separation chamber. As the wastewater flows into the separation chamber, a circular motion is generated that allows the water to pass through the cylindrical screen while forcing solids to swirl toward the center of the chamber where they are eventually removed.

5.1.2 Mechanical Screens

Mechanical step screens use perforated step panels to capture solids and transfer solids up to a discharge point where the debris is washed and brushed off into a compactor, conveyor or container. The design consists of two step-shaped sets of thin vertical plates, one fixed and one movable. The fixed and movable step plates alternate across the width of an open channel and together form a single screen. As the wastewater flows through the screen, solids and debris are captured on the screen. The movable plates rotate in a vertical motion lifting the solids up to the next step landing and eventually to the top of the screen where they are discharged to the collection hopper. This motion also acts to keep the screen clean of debris. Screen openings vary from 3 to 6 mm (0.12 or 0.24 inches).

5.2 PRIMARY TREATMENT

High rate primary treatment options evaluated include swirl concentrators, ballasted flocculation, and enhanced primary treatment.

5.2.1 Swirl Concentrators

Swirl concentrators, also known as vortex separators, are cylindrical devices that are used to separate particulate matter from water. Wastewater flow enters the swirl concentrator tangentially and travels in a vortex path of decreasing radius. Solids separation is caused by the inertia differential resulting from a nonlinear path of flow travel. Solids coalesce to the center, settle downward and are removed from the bottom as a dilute sludge known as underflow. The underflow from the swirl concentrators, typically 5 to 10 percent of the influent flow, must be further treated at the WWTP.

Swirl concentrators have no moving parts, operate at high hydraulic loading rates, are compact, and can remove a significant amount of settleable solids when properly sized and applied. However, solids removal efficiencies are lower compared to conventional clarifiers and other high rate technologies. For this reason, swirl concentrators are not recommended for treating Rock Island's CSOs.

5.2.2 Ballasted Flocculation

Ballasted flocculation is a high rate treatment process that uses a ballast mixed with the influent wastewater, polymer and coagulant to facilitate the formation of rapidly settling solids. The two most common and well-established technologies are Actiflo® and DensaDeg®. Each unit consists of a coagulation tank, flocculation tank and settling tank. Depending on the influent wastewater characteristics, both technologies require fine screens (1/4 inch or less) and grit removal to ensure effective performance.

The Actiflo® unit utilizes very small sand particles (microsand) to increase particle size, density, and settling velocity by binding to the solids. In addition to adding chemical coagulants and polymers to the influent wastewater, sand is also added. The settled sludge is passed through a hydrocyclone to recover the sand, which is returned to the process while the sludge is directed to further treatment. This unit does not have an internal recycle stream.

The DensaDeg® unit relies on the formation of dense sludge for optimum solids settling by adding chemical coagulants and polymers to the influent wastewater. This unit does not add sand. A portion of the settled sludge form the settling tank is recycled to the flocculation tank, which results in the formation of relatively dense floc which settle rapidly in the settling tank.

These high rate clarification technologies have resulted in solid removal efficiencies typically greater than 85%, but may tend to have higher operating costs due to chemical requirements. The facilities required for ballasted flocculation typically have a much smaller footprint than those required for other CSO treatment technologies. Thus, this technology is recommended for treating remote system CSOs in the City where space is limited.

5.2.3 Enhanced Primary Treatment

Chemically enhanced primary treatment utilizes conventional primary treatment (i.e., clarifiers) with chemical addition to facilitate solids settling at higher peak overflow rates. It is one of the simplest methods for increasing primary clarification treatment capacity. Chemical coagulants and polymer are added to the influent wastewater to destabilize the wastewater, accelerate the growth and weight of the flocs and increase particle specific gravity. Enhanced primary clarification results in effective BOD and solids removal, but may tend to have higher operating costs due to chemical requirements. The capital costs for this technology are much lower than those for ballasted flocculation. Due to its simplicity and low cost, enhanced primary treatment is recommended to treat the City's CSOs at the Mill Street Wastewater Treatment Plant site (CSO 001).

5.3 DISINFECTION

Options evaluated for disinfection of the wet weather flows include ultraviolet radiation (UV) and chlorine gas addition.

5.3.1 UV Disinfection

UV disinfection systems transfer electromagnetic energy from mercury arc lamps to the wastewater and rely on this UV radiation to penetrate the cell wall of an organism and destroy the cell's ability to reproduce. The effectiveness of a UV disinfection system depends on the characteristics of the wastewater, the intensity of UV radiation, the amount of time the microorganisms are exposed to the radiation, and the reactor configuration. Disinfection success is also directly related to the concentration of the colloidal and particulate constituents in the water.

UV Disinfection generally has much higher capital costs than chlorine disinfection, which can be overwhelming for locations where the facility would only be used a few times a year. UV also offers no way to immediately measure the disinfection effectiveness. Additionally, UV is a relatively new technology that the City is unfamiliar with. UV is not retained as a disinfection method for Rock Island. It is recognized that UV disinfection is an emerging technology that could be reconsidered during the design process.

5.3.2 Chlorination/Dechlorination

Chlorine is the most widely used disinfectant for municipal wastewater since it destroys target organisms by oxidizing cellular material. For optimum performance, a chlorine disinfection system should display plug flow and be highly turbulent for complete initial mixing in less than one second. In addition, sufficient contact time between the microorganisms and a minimal chlorine concentration is required for effective disinfection. Following disinfection, chlorine residual can persist in the effluent for many hours and in most states, chlorinated wastewater must often be dechlorinated. Dechlorination is the process of removing the free and combined chlorine residuals from the wastewater prior to discharge. Sulfur dioxide, sodium bisulfite, and sodium metabisulfate are the commonly used dechlorination chemicals. Disinfected CSOs in Rock Island will be dechlorinated if required.

The City currently uses chlorine gas disinfection facilities and has been very satisfied with them. Chlorine is reliable and relatively inexpensive. For these reasons, chlorination is recommended as the best disinfection method for treating the City's CSOs.

5.4 INCREASED SECONDARY TREATMENT

The potential for increased secondary treatment (WWTP expansion) was investigated by examining existing plant facilities and flow rates as documented in the *Mill Street Wastewater Treatment Plant Collection System and Capacity Analysis Technical Memorandum*. Of the existing plant facilities, the aeration system has the highest potential hydraulic capacity – 26 MGD. Thus, if the comminutors, grit basins, primary clarifier, and final clarifiers of the existing WWTP are expanded, the plant could treat a maximum of 26 MGD. To treat more than this, another treatment plant would have to be constructed.

Headworks reconstruction with segregation of stormwater input and new primary treatment is required to maximize use of the existing interceptor system. These new headworks facilities are assumed for all alternatives

The average daily dry weather flow rate to the WWTP is about 7 MGD. According to the Recommended Standards for Wastewater Facilities (1997) by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, a City the size of Rock Island should have a WWTP peaking factor (peak hourly flow/average design flow) of about 2.4. Thus, the maximum flow rate that the Rock Island WWTP should be able to handle is about 17 MGD, which is about the current plant capacity. Designing a plant to provide secondary biological treatment for flows higher than this may reduce the reliability and consistency of secondary treatment.

During wet weather, the flows coming to the treatment plant can reach well over 250 MGD – more than 15 times the plant's current capacity. Thus, for many wet weather events, increasing the treatment plant capacity would provide little benefit but incur a significant cost.

Considering the current plant peaking factor, the expected incremental benefit of expanding the WWTP, and the fact that the WWTP service area is fully developed, it is not recommended as a feasible treatment option for the City.

Section 6.0
DEVELOPMENT AND ANALYSIS OF PRELIMINARY ASSEMBLED ALTERNATIVES

Preliminary assembled alternatives were developed from the conveyance control technologies described in Section 4.0 and the treatment control technologies described in Section 5.0. The control technologies were assembled to create complete options that meet control goals identified in Section 2.0. Assembled alternative performance was evaluated using the SWMM model as described previously. Four assembled alternatives were developed for each the north and the south side of the city to provide a variety of options for further analysis and screening. The north and south sides of the city were evaluated independently because they are hydraulically separated until the flow from the north and south interceptors combines at the WWTP. Some of the eight assembled alternatives contain sub-alternatives, such as a choice between either a gravity sewer or a pump station and force main. The estimated costs for each alternative (or sub-alternative) are shown in Table 6-1. The American Association of Cost Engineers[1] states that, for budgeting purposes, actual cost should be assumed to be within +50/-30% of the estimated cost.

Table 6-1
Summary of Alternative Costs

Engineering News Record Construction Cost Index is 7298 (February 2005)

	NORTHSIDE		
Alternative 1			
Alternative 1a - Partial Separation			
Conveyance Components		$42.2	million
WWTP Components		$15.0	million
	TOTAL	*$57.2*	*million (+50/-30%)*
Alternative 1b - Full Separation			
Conveyance Components		$97.7	million
WWTP Components		$10.9	million
	TOTAL	*$108.6*	*million (+50/-30%)*

[1] Woodward, Charles P. (2003). Skills and Knowledge of Cost Engineering: Estimates. Retrieved February 22, 2006, from http://www.aacei.org/resources/public/2003AM_SK03.pdf. Presented at the 2003 Annual Meeting of the American Society of Cost Engineers in Orlando, Florida.

Table 6-1
Summary of Alternative Costs

Engineering News Record Construction Cost Index is 7298 (February 2005)

Alternative 2			
Alternative 2a - New Gravity North Interceptor			
Conveyance Components		$37.6	million
WWTP Components		$37.1	million
	TOTAL	*$74.7*	*million (+50/-30%)*
Alternative 2b - New Pumped North Interceptor			
Conveyance Components		$19.0	million
WWTP Components		$37.1	million
	TOTAL	*$56.1*	*million (+50/-30%)*
Alternative 3			
Alternative 3 - New Relief Sewer			
Conveyance Components		$11.6	million
WWTP Components		$37.1	million
	TOTAL	*$48.7*	*million (+50/-30%)*
Alternative 4			
Alternative 4a - New Gravity Interceptor to New CSO West of Centennial Bridge			
Conveyance Components		$31.6	million
WWTP Components		$25.8	million
	TOTAL	*$57.4*	*million (+50/-30%)*
Alternative 4b - New Pumped Interceptor to New CSO West of Centennial Bridge			
Conveyance Components		$23.2	million
WWTP Components		$25.8	million
	TOTAL	*$49.0*	*million (+50/-30%)*
SOUTHSIDE			
Alternative 5			
Alternative 5 - Removal of Stormwater Sources & Relocation of CSO 007			
Conveyance Components		$14.3	million
WWTP Components*		$0.0	million
	TOTAL	*$14.3*	*million (+50/-30%)*

Table 6-1
Summary of Alternative Costs

Engineering News Record Construction Cost Index is 7298 (February 2005)

Alternative 6			
Alternative 6a - New Storage Tank & Relocation of CSO 007			
Conveyance Components		$8.7	million
WWTP Components*		$0.0	million
	TOTAL	*$8.7*	*million (+50/-30%)*
Alternative 6b - Increased Conveyance Around BHLS & Relocation of CSO 007			
Conveyance Components		$3.6	million
WWTP Components*		$0.0	million
	TOTAL	*$3.6*	*million (+50/-30%)*
Alternative 7			
Alternative 7 - New South Interceptor			
Conveyance Components		$18.3	million
WWTP Components*		$1.6	million
	TOTAL	*$19.9*	*million (+50/-30%)*
Alternative 8			
Alternative 8a - New Relief Sewer from Franciscan & Relocation of CSO 007			
Conveyance Components		$5.6	million
WWTP Components*		$1.5	million
	TOTAL	*$7.1*	*million (+50/-30%)*
Alternative 8b - Increased Treatment at Franciscan & Relocation of CSO 007			
Conveyance Components		$7.6	million
WWTP Components*		$0.0	million
	TOTAL	*$7.6*	*million (+50/-30%)*
Alternative 8c - New Relief Sewer from Saukie & Franciscan			
Conveyance Components		$5.6	million
WWTP Components*		$2.1	million
	TOTAL	*$7.7*	*million (+50/-30%)*
Alternative 8d - Increased Treatment at Saukie & Franciscan			
Conveyance Components		$9.0	million
WWTP Components*		$0.0	million
	TOTAL	*$9.0*	*million (+50/-30%)*

*cost for WWTP components in addition to those required for any northside alternative

6.1 ALTERNATIVE 1 – NORTHSIDE SOURCE CONTROL

Alternative 1 involves reducing wet weather flow into the sewer system by separating the combined sewer system into two separate sewer systems, one for sanitary flow and one for stormwater flow. Alternative 1a uses partial separation which involves building new storm sewers and continuing to use the existing combined sewers to carry sanitary and some wet weather flow. Alternative 1b involves full separation which involves constructing new sanitary sewers and continuing to use the existing combined sewers to carry stormwater flow.

6.1.1 Alternative 1a – Northside Partial Separation

Partial Separation is the main feature of Alternative 1a. Because partial separation would not completely eliminate the overflows at CSOs 003, 004, and 005, the remaining overflow would have to be conveyed through a new parallel 60" north interceptor starting at CSO 005 and ending at the existing north interceptor around 18th Street and 1st Avenue. From that point to the WWTP the existing interceptor would be sufficient to convey the expected flow rate. The proposed storage tank at 40th Street and 5th Avenue addresses a local flooding issue and is included in all of the northside alternatives. Enhanced primary treatment is necessary to meet the presumption approach at CSO 001 (at the WWTP). All remaining overflows at CSO 001 would be screened and disinfected to meet water quality requirements. The key components of Alternative 1a are further illustrated in Figures 1, 2, and 3 and listed below:

Conveyance

- partial separation of the 1,138 acres of combined sewers remaining in the city
- 2,600' of new 60" interceptor from CSO 005 west parallel to existing interceptor
- 1.7 MG storage tank at 40th St. & 5th Ave.
- New outfall pipe at WWTP
- Cost: $42.2 million

Treatment at Mill Street WWTP

- 84 MGD influent pump station at WWTP
- 84 MGD fine screens at WWTP
- new 16 MGD mechanical fine screens with washing & compaction at WWTP
- 33 MGD chemically enhanced primary treatment facility at WWTP
- 0.5 MGD sludge pump station at WWTP
- solids handling equipment at WWTP
- 84 MGD chlorine gas disinfection facility at WWTP
- new outfall pipe
- Cost: $15.0 million

TOTAL COST: $57.2 million (+50/-30%)

Alternative 1a costs are just barely 15% greater than the lowest cost alternative. This alternative provides additional benefit to the City because street improvements would be realized in conjunction with the sewer separation work. An additional benefit would be a significant reduction in flow rates throughout the system which would reduce system backups. A disadvantage of this alternative is that pollutants in runoff that are now captured by the combined sewers and treated at the WWTP would be discharged as stormwater after the sewers are separated. Stormwater BMPs, which are not included in the cost for this alternative, would be necessary to achieve stormwater pollutant reduction. Separated areas would require management under the city's NPDES stormwater permitting program.

6.1.2 Alternative 1b – Northside Full Separation

The main feature of Alternative 1b is full separation. Full separation would be sufficient to eliminate overflows at CSO 003-006. The proposed storage tank at 40th Street and 5th Avenue addresses a local flooding issue and is included in all of the northside alternatives. Increased primary treatment is necessary to meet the presumption approach at CSO 001 (at the WWTP). All overflows at CSO 001 would have to be screened and disinfected to meet water quality requirements. The key components of Alternative 1b are further illustrated in Figures 4, 5, and 6 and listed below:

Conveyance
- full separation of the 1,138 acres of combined sewers remaining in the city
- 1.7 MG storage tank at 40th St. & 5th Ave.
- Cost: $97.7 million

Treatment at Mill Street WWTP
- 30 MGD influent pump station at WWTP
- 30 MGD fine screens at WWTP
- new 16 MGD mechanical fine screens with washing & compaction at WWTP
- 16 MGD chemically enhanced primary treatment facility at WWTP
- 0.5 MGD sludge pump station at WWTP
- solids handling equipment at WWTP
- 30 MGD chlorine gas disinfection facility at WWTP
- new outfall pipe
- Cost: $10.9 million

TOTAL COST: $108.6 million (+50/-30%)

This alternative costs 45% more than the next closest alternative (2a) and over twice as much as the lowest cost alternative (3). Although this alternative would meet the City's goals, it would cause substantial construction disruption throughout the entire downtown area and in several dense residential areas. Significant private property work would be required to fully separate sanitary and stormwater flows. Also, pollutants in runoff that are now captured by the combined sewers and treated at the WWTP would be discharged as stormwater after the sewers are separated. Stormwater BMPs, which are not included in the cost for this alternative, would be necessary to achieve stormwater pollutant reduction.

Separated areas would require management under the city's NPDES stormwater permitting program.

6.2 ALTERNATIVE 2 - INCREASED CONVEYANCE TO THE WWTP ALONG THE EXISTING NORTH INTERCEPTOR ROUTE

Alternative 2 increases the conveyance to the WWTP along the existing north interceptor such that CSOs 003-006 can be eliminated. Alternative 2a uses a new parallel gravity sewer to increase conveyance and Alternative 2b uses a pump station and force main to increase conveyance.

6.2.1 Alternative 2a – New Gravity North Interceptor

A new gravity north interceptor is the main feature of Alternative 2a. The new parallel interceptor is designed to carry to the overflows from CSOs 003-006 to the WWTP, thereby eliminating them. The proposed storage tank at 40th Street and 5th Avenue addresses a local flooding issue and is included in all of the northside alternatives. Enhanced primary treatment and disinfection is necessary to meet the presumption approach at CSO 001 (at the WWTP). All overflows at CSO 001 would have to be screened and disinfected to meet water quality requirements. The key components of Alternative 2a are further illustrated in Figure 7, 10, and 11 and listed below:

Conveyance
- 13,250' of new 36"-102" interceptor sewer from CSO 006 to WWTP parallel to existing interceptor
- 1.7 MG storage tank at 40th St. & 5th Ave.
- Cost: $37.6 million

Treatment at Mill Street WWTP
- 281 MGD influent pump station at WWTP
- 265 MGD fine screens at WWTP
- new 16 MGD mechanical fine screens with washing & compaction at WWTP
- 90 MGD (5 MG) chemically enhanced primary treatment facility at WWTP
- 0.5 MGD sludge pump station at WWTP
- solids handling equipment at WWTP
- 230 MGD chlorine gas disinfection facility at WWTP
- new outfall pipe
- Cost: $37.1 million

TOTAL COST: $74.7 million (+50/-30%)

The alternative has the second highest cost (about 150% more than the low cost alternative). In addition, the geotechnical considerations due to the proximity to the levee may further increase costs. Similar to this, maintenance cost might be higher than average because of sediment settling similar to the existing north interceptor due to its shallow slopes and typically low flow rates.

6.2.2 Alternative 2b – New Pumped North Interceptor

Alternative 2b would relieve the north interceptor by pumping it out at CSO 005 and conveying it via a new north interceptor force main to the WWTP. The pumping would restore enough capacity in the interceptor such that what currently overflows at CSOs 003 and 004 would be able to enter the existing interceptor and be conveyed to the WWTP. Thus outfalls 003, 004, and 005 would be eliminated. To eliminate CSO 006, its tributary basin would be partially separated. The proposed storage tank at 40th Street and 5th Avenue addresses a local flooding issue and is included in all of the northside alternatives. Increased primary treatment is necessary to meet the presumption approach at CSO 001 (at the WWTP). All overflows at CSO 001 would be screened and disinfected to meet water quality requirements. The key components of Alternative 2b are further illustrated in Figures 8, 10, and 11 and listed below:

<u>Conveyance</u>

- 113 MGD pump station at CSO 005
- 0.6 MG storage tank at pump station
- 10,985′ of new 54″ force main from pump station
- partial separation of 70 acres of combined sewers upstream of CSO 006
- 1.7 MG storage tank at 40th St. & 5th Ave.
- Cost: $19.0 million

<u>Treatment at Mill Street WWTP</u>

- 281 MGD influent pump station at WWTP
- 265 MGD fine screens at WWTP
- new 16 MGD mechanical fine screens with washing & compaction at WWTP
- 90 MGD (5 MG) chemically enhanced primary treatment facility at WWTP
- 0.5 MGD sludge pump station at WWTP
- solids handling equipment at WWTP
- 230 MGD chlorine gas disinfection facility at WWTP
- new outfall pipe
- Cost: $37.1 million

TOTAL COST: $56.1 million (+50/-30%)

The total cost of Alternative 2b is within 15% of the cost of the low cost alternative and thus it is recommended for detailed evaluation. The use of a force main minimizes the pipe size and depth compared to using a gravity sewer and thus decreases the disturbance due to construction. Disturbance is also minimized by only partially separating about 6% of the combined area. Another benefit of the force main is that it would not be subject to the sedimentation problems of a gravity sewer and thus be easier to maintain. However, the pump station required for this alternative would create substantially more energy costs than an all gravity sewer alternative.

6.3 ALTERNATIVE 3 – NEW RELIEF SEWER ALONG 6TH AVENUE

Alternative 3 includes construction of a relief sewer from 24th Street to the WWTP along 6th Avenue. The relief sewer would intercept a substantial amount of flow from the north-south trunk sewers that feed the north interceptor and CSOs 003-005 and carry it directly to the treatment plant. Flow that enters the trunk sewers and interceptor downstream (south) of the relief sewer interception points would be carried to the wastewater treatment plant through the existing north interceptor. A new parallel sewer is required from CSO 005 to the existing north interceptor around 18th Street and 1st Avenue. These new sewers would eliminate CSOs 003-005. To eliminate CSO 006, its tributary basin would be partially separated. The proposed storage tank at 40th Street and 5th Avenue addresses a local flooding issue and is included in all of the northside alternatives. Increased primary treatment is necessary to meet the presumption approach at CSO 001 (at the WWTP). All overflows at CSO 001 would have to be screened and disinfected to meet water quality requirements. The key components of Alternative 3 are further illustrated in Figures 9, 10, and 11 and are listed below:

<u>Conveyance</u>

- 6,811′ of new 54″-66″ relief sewer along 6th Ave
- partial separation of 70 acres of combined sewers upstream of CSO 006
- 2,600′ of new 60″ interceptor from CSO 005 parallel to existing interceptor
- 1.7 MG storage tank at 40th St. & 5th Ave.
- Cost: $11.6 million

<u>Treatment at Mill Street WWTP</u>

- 281 MGD influent pump station at WWTP
- 265 MGD fine screens at WWTP
- new 16 MGD mechanical fine screens with washing & compaction at WWTP
- 90 MGD (5 MG) chemically enhanced primary treatment facility at WWTP
- 0.5 MGD sludge pump station at WWTP
- solids handling equipment at WWTP
- 230 MGD chlorine gas disinfection facility at WWTP
- new outfall pipe
- Cost: $37.1 million

TOTAL COST: $48.7 million (+50/-30%)

Alternative 3 is the lowest cost alternative. Sixth Avenue is a low traffic volume street surrounded by a fairly low density residential area. Thus, a small percentage of the population would be affected by the construction disturbance. Construction disruption would also be minimized by this alternative by only partially separating about 6% of the combined area instead of the entire city.

6.4 ALTERNATIVE 4 – CONSOLIDATION OF CSOS 002-006 WEST OF CENTENNIAL BRIDGE

Alternative 4 involves consolidating outfalls 003-006 at a new, relocated CSO outside of the Sylvan Slough sensitive area. The CSO flows would be conveyed from the existing outfall locations to the new outfall by either a gravity sewer (Alternative 4a) or a force main (Alternative 4b). At the new outfall wet weather treatment facilities would be installed to meet the presumption approach goals.

6.4.1 Alternative 4a – New Gravity North Interceptor to New CSO

Alternative 4a includes construction of a new parallel north interceptor from CSO 006 to a new CSO south of Centennial Bridge. Because of the required slope for the new sewer there would have to be a pump station at the new CSO to pump the flow to the Mississippi River. Primary treatment, screening, and disinfection would also be required at the new outfall. Ballasted flocculation would be employed for primary treatment due to the small amount of land available. The proposed storage tank at 40th Street and 5th Avenue addresses a local flooding issue and is included in all of the northside alternatives. Increased primary treatment is necessary to meet the presumption approach at CSO 001 (at the WWTP). All overflows at CSO 001 would have to be screened and disinfected to meet water quality requirements. The key components of Alternative 4a are further illustrated in Figures 12, 14, and 15 and listed below:

Conveyance
- 6,308' of new 36"-96" interceptor sewer from CSO 006 parallel to existing interceptor
- 113 MGD pump station at new CSO
- 0.6 MG of storage at new CSO
- 500' of new 54" force main
- new outfall structure
- 20 MGD & 121 MGD fine screens at new outfall
- 20 MGD ballasted flocculation facility at new outfall
- 141 MGD chlorine gas disinfection facility at new outfall
- 1.7 MG storage tank at 40th St. & 5th Ave.
- Cost: $31.6 million

Treatment at Mill Street WWTP
- 186 MGD influent pump station at WWTP
- 170 MGD fine screens at WWTP
- new 16 MGD mechanical fine screens with washing & compaction at WWTP
- 60 MGD (3 MG) chemically enhanced primary treatment facility at WWTP
- 0.5 MGD sludge pump station at WWTP
- solids handling equipment at WWTP
- 130 MGD chlorine gas disinfection facility at WWTP
- new outfall pipe
- Cost: $25.8 million

TOTAL COST: $57.4 million (+50/-30%)

Alternative 4a costs slightly over 15% more than the lowest cost alternative. This alternative has constructability issues similar to Alternative 2a. Also, the use of chlorine gas will require risk management control measures due to the site proximity to a residential population. (Sodium hypochlorite cannot be used because of its fast degradation time and the large storage area that it requires.)

6.4.2 Alternative 4b – New Pumped North Interceptor to New CSO

The main feature of Alternative 4b is a new pump station at CSO 005 to convey water through a new force main to a new CSO south of Centennial Bridge. Primary treatment, screening, and disinfection would be required at the new outfall. Ballasted flocculation would be employed for primary treatment due to the small amount of land available. The pumping would restore enough capacity in the interceptor such that what currently overflows at CSOs 003 and 004 would be able to enter the existing interceptor and be conveyed to the WWTP. Thus outfalls 003, 004, and 005 would be eliminated. To eliminate CSO 006, its tributary basin would be partially separated. The proposed storage tank at 40th Street and 5th Avenue addresses a local flooding issue and is included in all of the northside alternatives. Increased primary treatment is necessary to meet the presumption approach at CSO 001 (at the WWTP). Overflows at CSO 001 would be screened and disinfected to meet water quality requirements. The key components of Alternative 4b are further illustrated in Figures 13, 14, and 15 and listed below:

<u>Conveyance</u>

- 4,500′ of new 54″ force main from CSO 005
- 113 MGD pump station at CSO 005
- 0.6 MG of storage at CSO 005
- new outfall structure
- 20 MGD & 121 MGD fine screens at new outfall
- 20 MGD ballasted flocculation facility at new outfall
- 141 MGD chlorine gas disinfection facility at new outfall
- partial separation of 70 acres of combined sewers upstream of CSO 006
- 1.7 MG storage tank at 40th St. & 5th Ave.
- Cost: $23.2 million

<u>Treatment at Mill Street WWTP</u>

- 186 MGD influent pump station at WWTP
- 170 MGD fine screens at WWTP
- new 16 MGD mechanical fine screens with washing & compaction at WWTP
- 60 MGD (3 MG) chemically enhanced primary treatment facility at WWTP
- 0.5 MGD sludge pump station at WWTP
- solids handling equipment at WWTP
- 133 MGD chlorine gas disinfection facility at WWTP
- new outfall pipe
- Cost: $25.8 million

TOTAL COST: $49.0 million (+50/-30%)

Alternative 4b is the second lowest cost alternative. The use of a force main decreases the pipe size and depth compared to using a gravity sewer and thus decreases the disturbance due to construction. Disturbance is also minimized by only partially separating about 6% of the combined area. The force main would not be subject to the sedimentation problems of a gravity sewer and thus be easier to maintain. The use of chlorine gas will require risk management control measures due to the site proximity to a residential population. (Sodium hypochlorite cannot be used because of its fast degradation time and the large storage area that it requires.)

6.5 ALTERNATIVE 5 – SOUTHSIDE SOURCE CONTROL

Alternative 5 involves further separating the partially separated southside areas that still experience fairly high wet weather inflows and moving CSO 007 downstream of the BHLS. Based on the existing amount of sewers, the City assumed that about 40,000′ additional feet of storm sewer would have to be laid in the areas shown in Figure 14 to sufficiently reduce inflow to the partially separated sanitary sewers. A significant number of private property repairs, including the disconnection of foundation drains, downspouts, and sump pumps from the partially separated sanitary sewers, would also have to be performed. In addition, CSO 007 would be moved from its current location on Black Hawk Creek to around 49th Avenue and Highway 67. A new gravity sewer would carry the CSO flow south to the Rock River, passing through screening and disinfection facilities along the way. Modifications to meet the IEPA first flush requirement at CSO 011 and 012 would also have to be completed and are included as part of all southside alternatives. With this alternative no treatment would be necessary at the WWTP in addition to what is required for the chosen northside alternative. The key components of Alternative 5 are further illustrated in Figure 16 and listed below:

<u>Conveyance</u>

- 40,000′ of new 15″-24″ storm sewer
- private property repairs for up to 40% of all parcels
- 1,350′ of new 30″ outfall pipe
- new outfall structure
- 20 MGD fine screen at relocated outfall
- 20 MGD chlorine disinfection facility at relocated outfall
- reconfiguration of Saukie & Franciscan control logic
- modifications at Saukie and Franciscan to meet IEPA first flush requirement
- Cost: $14.3 million

<u>Treatment at Mill Street WWTP</u>

- no upgrades required

TOTAL COST: $14.3 million (+50/-30%)

This is the second most costly alternative for the southside. It costs almost 60% more than the next lowest cost alternative (8d). The alternative would involve significant disruption on both public and private property. To ensure the effectiveness of this alternative, peak flow reduction would need to be demonstrated through demonstration projects (not included in the above cost).

6.6 ALTERNATIVE 6 – RELOCATION OF CSO 007

Alternative 6 involves both relocating outfall 007, as discussed under Alternative 5, but also adding new facilities not far upstream of the BHLS. Alternative 6a specifies the construction of a storage tank at the junction of the trunk sewer from Saukie and Franciscan treatment tanks. Alternative 6b involves building a parallel interceptor sewer from the junction of the Saukie and Franciscan trunk sewers to BHLS as well as increasing the capacity of BHLS.

6.6.1 Alternative 6a – New Storage Tank and Relocation of CSO 007

This alternative prevents overflows at the existing CSO 007 location with the construction of a storage tank at the junction of the two major southside trunk sewers. When the downstream sewers start to surcharge the excess sewage would be stored in the tank until capacity is restored downstream. It is assumed for this alternative that BHLS would be able to pump at its full capacity such that most excess flow would be sent down to the south interceptor and relocated CSO 007 at about 49th Avenue and Highway 67. A new gravity outfall sewer would carry the CSO flow south to the Rock River, passing through screening and disinfection facilities along the way. Modifications to meet the IEPA first flush requirement at CSO 011 and 012 would also have to be completed and are included as part of all southside alternatives. With this alternative no treatment would be necessary at the WWTP in addition to what is required for the chosen northside alternative. The key components of Alternative 6a are further illustrated in Figure 17 and listed below:

Conveyance
- 2.7 MG storage tank at fitness center
- 100' of 36" sewer connecting to storage tank
- 1,350' of new 30" outfall pipe
- new outfall structure
- 20 MGD fine screen at relocated outfall
- 20 MGD chlorine disinfection facility at relocated outfall
- reconfiguration of Saukie & Franciscan control logic
- modifications at Saukie and Franciscan to meet IEPA first flush requirement
- Cost: $8.7 million

Treatment at Mill Street WWTP
- no upgrades required

TOTAL COST: $8.7 million (+50/-30%)

The cost for this alternative is over 20% higher than the cost of the second lowest cost alternative (8a). The storage tank for this alternative would consume most, if not all, of the available land surrounding the fitness center. Geotechnical and geographical issues may increase tank construction costs. This site is located between two creeks and steep grades of adjacent ravines.

6.6.2 Alternative 6b – Increased Conveyance to and from BHLS and Relocation of CSO 007

To eliminate overflows at the existing CSO 007 this alternative involves a parallel interceptor to and increased pumping capacity at BHLS. CSO 007 would be relocated to about 49th Avenue and Highway 67 to discharge flow from the BHLS that would not fit into the south interceptor. A new gravity outfall sewer would carry the CSO flow south to the Rock River, passing through screening and disinfection facilities along the way. Modifications to meet the IEPA first flush requirement at CSO 011 and 012 would also have to be completed and are included as part of all southside alternatives. With this alternative no treatment would be necessary at the WWTP in addition to what is required for the chosen northside alternative. The key components of Alternative 6b are further illustrated in Figure 18 and listed below:

Conveyance

- 1,100′ of new 36″ interceptor sewer upstream of BHLS
- 387′ of two new 36″ siphons under Black Hawk Creek
- upgrade of BHLS from 20 to 23.5 MGD capacity
- 1,350′ of new 30″ outfall pipe
- new outfall structure
- 20 MGD fine screen at relocated outfall
- 20 MGD chlorine disinfection facility at relocated outfall
- reconfiguration of Saukie & Franciscan control logic
- modifications at Saukie and Franciscan to meet IEPA first flush requirement
- Cost: $3.6 million

Treatment at Mill Street WWTP

- no upgrades required

TOTAL COST: $3.6 million (+50/-30%)

This alternative has lowest cost of all of the southside options. The alternative would provide redundancy for the existing interceptor allowing for a backup in case of pipe failure with easier maintenance.

6.7 ALTERNATIVE 7 – INCREASED CONVEYANCE TO WWTP

Alternative 7 involves construction a new parallel south interceptor and building the storage tank described for Alternative 6a. To prevent overflows at the existing CSO 007 location a storage tank would be built upstream at the junction of the two major southside trunk sewers. When the downstream sewers start to surcharge the excess sewage would be stored in the tank until capacity is restored downstream. It is assumed for this alternative that BHLS would be able to pump at its full capacity such that most excess flow would be sent down to the south interceptor. The existing south interceptor does not have capacity to accept the full capacity flow from BHLS. Thus, this alternative involves the construction of a new south interceptor from about 49th Avenue and Highway 67 to 18th Avenue and 1st Street where the existing south interceptor is 72″ in diameter. The entire existing south interceptor would remain in operation. Modifications to meet the IEPA first flush requirement at CSO 011 and 012 would also have to be completed and are included as part of all southside alternatives.

Because of the excess flow that would be delivered to the WWTP through the new interceptor, the pumping, screening, and disinfection facilities that must be built at the WWTP as part of the chosen northside alternative would have to be further upgraded. The key components of Alternative 7 are further illustrated in Figure 19 and listed below:

<u>Conveyance</u>
- 14,768′ of new 36″-42″ south interceptor sewer
- 2.7 MG storage tank at fitness center
- 100′ of 36″ sewer connecting to storage tank
- modifications at Saukie and Franciscan to meet IEPA first flush requirement
- Cost: $18.3 million

<u>Treatment at Mill Street WWTP</u>
- 20 MGD of additional pumping, screening, and disinfection at WWTP
- Cost: $1.6 million

TOTAL COST: $19.9 million (+50/-30%)

This alternative is the most expensive of all of the southside options. It costs almost 40% more than the next lowest cost alternative (5). A significant length of the new interceptor runs through city neighborhoods, causing significant disruption during construction.

6.8 ALTERNATIVE 8 – INCREASED DIVERSION AT SAUKIE AND FRANCISCAN TREATMENT FACILITIES

Alternative 8 focuses on making modifications at the existing Saukie and Franciscan storage/treatment facilities. There are four sub-alternatives which vary according to whether both Saukie and Franciscan are modified or just Franciscan and by whether the treatment capabilities at the basins are upgraded or the excess flow is pumped west to the 72″ portion of the existing south interceptor.

6.8.1 Alternative 8a – New Relief Sewer from Franciscan and Relocation of CSO 007

For this alternative a new pump station would be constructed by the Franciscan storage/treatment tank to divert all wet weather flow (in excess of the existing Franciscan treatment capacity) to the 72″ portion of the south interceptor via a new force main relief sewer. Flow from the Saukie trunk sewer would still reach the BHLS and need to be pumped to the south interceptor. CSO 007 would be relocated to about 49th Avenue and Highway 67 to discharge flow from the BHLS that would not fit into the south interceptor. A new gravity sewer would carry the CSO flow south to the Rock River, passing through screening and disinfection facilities along the way. Modifications to meet the IEPA first flush requirement at CSO 011 and 012 would also have to be completed and are included as part of all southside alternatives.

Because of the excess flow that would be delivered to the WWTP through the new relief sewer, the pumping, screening, and disinfection facilities that must be built at the WWTP as part of the chosen northside alternative would have to be further upgraded. The key components of Alternative 8a are further illustrated in Figure 20 and listed below:

Conveyance
- upgraded Franciscan pumps, 3.6 MGD to 18.6 MGD
- 11,520' of new 20" force main from Franciscan to south interceptor
- 1,350' of new 30" outfall pipe
- new outfall structure
- 20 MGD fine screen at relocated outfall
- 20 MGD chlorine disinfection facility at relocated outfall
- reconfiguration of Saukie & Franciscan control logic
- modifications at Saukie and Franciscan to meet IEPA first flush requirement
- Cost: $5.6 million

Treatment at Mill Street WWTP
- 15 MGD of additional pumping, screening, and disinfection at WWTP
- Cost: $1.5 million

TOTAL COST: $7.1 million (+50/-30%)

The cost for this alternative is the second lowest of the southside options. It costs almost twice as much as the lowest cost alternative (6b). This alternative involves relocating CSO 007 to 49th Avenue and Highway 67 and avoids sending excess treated sewage to Black Hawk Creek.

6.8.2 Alternative 8b – Increased Treatment at Franciscan and Relocation of CSO 007

Alternative 8b is similar to alternative 8a, except instead of pumping the excess flow at the Franciscan treatment tank to the south interceptor, the flow is pumped to expanded treatment facilities by the existing Franciscan treatment facility. Due to space limitations, the expanded treatment would have to be a ballasted flocculation facility. Modifications to meet the IEPA first flush requirement at CSO 011 and 012 would also have to be completed and are included as part of all southside alternatives. With this alternative no treatment would be necessary at the WWTP in addition to what is required for the chosen northside alternative. The key components of Alternative 8b are further illustrated in Figure 21 and listed below:

Conveyance

- upgraded Franciscan pumps, 3.6 MGD to 18.6 MGD
- 20 MGD fine screen at Franciscan
- 15 MGD ballasted flocculation facility at Franciscan
- 15 MGD chlorine gas disinfection facility at Franciscan
- 1,350′ of new 30″ outfall pipe
- new outfall structure
- 20 MGD fine screen at relocated outfall
- 20 MGD chlorine disinfection facility at relocated outfall
- reconfiguration of Saukie & Franciscan control logic
- modifications at Saukie and Franciscan to meet IEPA first flush requirement
- Cost: $7.6 million

Treatment at Mill Street WWTP

- no upgrades required at WWTP

TOTAL COST: $7.6 million (+50/-30%)

The cost for this alternative is less than 10% higher than the second lowest cost alternative (8a). This alternative would send more wet weather flow (receiving primary treatment and disinfection) to Black Hawk Creek.

6.8.3 Alternative 8c – New Relief Sewer from Saukie and Franciscan

Alternative 8c involves constructing new pump stations by the Franciscan and Saukie storage/treatment tanks to divert all wet weather flow (in excess of what can currently be diverted to the treatment tanks) to the 72″ portion of the south interceptor via a new force main relief sewer. With this alternative CSO 007 would be completely eliminated, not relocated. Modifications to meet the IEPA first flush requirement at CSO 011 and 012 would have to be completed and are included as part of all southside alternatives. Because of the excess flow that would be delivered to the WWTP through the new relief sewer, the pumping, screening, and disinfection facilities that must be built at the WWTP as part of the chosen northside alternative would have to be further upgraded. The key components of Alternative 8c are further illustrated in Figure 22 and listed below:

Conveyance

- upgraded Franciscan pumps, 3.6 MGD to 18.6 MGD
- 11,520′ of new 20″ force main from Franciscan to south interceptor
- upgraded Saukie pumps, 3.6 MGD to 13.6 MGD
- 6,210′ of new 18″ force main from Saukie to Franciscan
- modifications at Saukie and Franciscan to meet IEPA first flush requirement
- Cost: $5.6 million

Treatment at Mill Street WWTP

- 25 MGD of additional pumping, screening, and disinfection at WWTP
- Cost: $2.1 million

TOTAL COST: $7.7 million (+50/-30%)

The cost for this alternative is less than 10% higher than the second lowest cost alternative (8a). With this alternative Outfall 007 is eliminated, not relocated.

6.8.4 Alternative 8d – Increased Treatment at Saukie and Franciscan

This alternative is similar to alternative 8c, except instead of pumping the excess flow at the treatment tanks to the south interceptor, the flow is pumped to expanded treatment facilities by the existing Saukie and Franciscan treatment facilities. Due to space limitations, the expanded treatment would have to be ballasted flocculation facilities. Modifications to meet the IEPA first flush requirement at CSO 011 and 012 would also have to be completed and are included as part of all southside alternatives. With this alternative no treatment would be necessary at the WWTP in addition to what is required for the chosen northside alternative. The key components of Alternative 8d are further illustrated in Figure 23 and listed below:

Conveyance
- upgraded Franciscan pumps, 3.6 MGD to 18.6 MGD
- upgraded Saukie pumps, 3.6 MGD to 13.6 MGD
- 20 MGD fine screen at Franciscan
- 15 MGD ballasted flocculation facility at Franciscan
- 15 MGD chlorine gas disinfection facility at Franciscan
- upgraded Saukie pumps, 3.6 MGD to 13.6 MGD
- 20 MGD fine screen at Saukie
- 10 MGD ballasted flocculation facility at Saukie
- 10 MGD chlorine gas disinfection facility at Saukie
- modifications at Saukie and Franciscan to meet IEPA first flush requirement
- Cost: $9.0 million

Treatment at Mill Street WWTP
- no upgrades required at WWTP

TOTAL COST: $9.0 million (+50/-30%)

The cost for this alternative is over 25% higher than the second lowest cost alternative (8a). This alternative requires sending more treated overflow into Black Hawk Creek.

6.9 ALTERNATIVE SCREENING

The alternatives described above are compared in the tables below. The tables indicate which alternatives will be retained for detailed evaluation.

Table 6-2. Preliminary Screening of Northside Alternatives

Alternative	Advantages	Disadvantages	Screening Result
1a Partial Separation	• *Construction cost just barely 15% greater than the lowest cost alternative.* • Potential to do street improvements in conjunction with sewer separation work. • Reduction in system backups due to reduction in flow rates. • Work on private property not necessary. • Northside CSOs eliminated.	• Substantial construction disruption throughout the entire downtown area and in several dense residential areas. • Likely water quality problem created from the polluted stormwater entering the river. • Long-term maintenance costs for stormwater pump station. • Long-term disruption to levee bike path from stormwater pump station.	RETAINED

Table 6-2. Preliminary Screening of Northside Alternatives			
Alternative	**Advantages**	**Disadvantages**	**Screening Result**
1b Full Separation	• Potential to do street improvements in conjunction with sewer separation work. • Reduction in system backups due to reduction in flow rates throughout the system. • Northside CSOs eliminated.	• *Construction cost over 45% more than the next closest alternative and over twice as much as the lowest cost alternatives.* • Substantial construction disruption throughout the entire downtown area and in several dense residential areas. • Significant work on private property required to fully separate sanitary and stormwater flows. • Likely water quality problem created from the polluted stormwater entering the river. • Long-term maintenance costs for stormwater pump station. • Long-term disruption to levee bike path from stormwater pump station.	ELIMINATED
2a New Gravity North Interceptor	• No remote pump station required. • Work on private property not necessary. • Northside CSOs eliminated.	• *Second highest construction cost (about 150% more than the low cost alternative).* • Potential for construction cost increase due to proximity to the levee. • Potential for higher than average sewer maintenance costs due to sediment settling in shallow pipe with low flow.	ELIMINATED

Table 6-2. Preliminary Screening of Northside Alternatives			
Alternative	**Advantages**	**Disadvantages**	**Screening Result**
2b New Pumped North Interceptor	• *Construction cost within 15% of the cost of the low cost alternative.* • Construction disturbance minimization by using smaller and shallower force main instead of gravity sewer. • Construction disturbance minimization by partially separating only 6% of the combined area. • Easier sewer maintenance due to lack of sedimentation problems in gravity sewers. • Work on private property not necessary. • Northside CSOs eliminated.	• Long-term maintenance costs for CSO pump station. • Long-term disruption to levee bike path from CSO pump station.	RETAINED
3 New Relief Sewer	• *Lowest construction cost.* • Construction disturbance minimization using low traffic volume street surrounded by a fairly low density residential area for new relief sewer. • Construction disturbance minimization by partially separating only 6% of the combined area. • No remote pump station required. • Work on private property not necessary. • Northside CSOs eliminated.	• Potential for higher than average sewer maintenance costs due to sediment settling in shallow pipe with low flow.	RETAINED

Table 6-2. Preliminary Screening of Northside Alternatives			
Alternative	**Advantages**	**Disadvantages**	**Screening Result**
4a New Gravity Interceptor to New CSO West of Centennial Bridge	• Work on private property not necessary.	• *Construction costs slightly over 15% more than the lowest cost alternative.* • Potential for construction cost increase due to proximity to the levee. • Potential for higher than average sewer maintenance costs due to sediment settling in shallow pipe with low flow. • New northside CSO created. • Long-term maintenance cost for remote treatment facility. • Long-term disruption to levee bike path by remote treatment facility.	ELIMINATED
4b New Pumped Interceptor to New CSO West of Centennial Bridge	• *Second lowest construction cost.* • Construction disturbance minimization by using smaller and shallower force main instead of gravity sewer. • Construction disturbance minimization by partially separating only 6% of the combined area. • Easier sewer maintenance due to lack of sedimentation problems in gravity sewers. • Work on private property not necessary.	• Long-term maintenance costs for CSO pump station. • Long-term disruption to levee bike path from CSO pump station. • New northside CSO created. • Long-term maintenance costs for remote treatment facility. • Long-term disruption to levee bike path by remote treatment facility.	RETAINED

Table 6-3. Preliminary Screening of Southside Alternatives			
Alternative	**Advantages**	**Disadvantages**	**Screening Result**
5 Removal of Stormwater Sources & Relocation of CSO 007	• Reduction in system backups due to reduction in flow rates.	• *Second most costly construction.* • Significant disruption on both public and private property. • Requires demonstration of peak flow reduction through demonstration projects (not included in the above cost). • CSO 007 is relocated, not eliminated. • Long-term maintenance costs for relocated CSO.	ELIMINATED
6a New Storage Tank & Relocation of CSO 007	• Construction disruption only in concentrated areas.	• *Construction cost is over 20% more than second lowest cost alternative.* • Construction costs might increase due to geotechnical and geographical issues. • CSO 007 is relocated, not eliminated. • Long-term maintenance costs for relocated CSO.	ELIMINATED
6b Increased Conveyance Around BHLS & Relocation of CSO 007	• *Lowest construction cost.* • Provides redundancy for existing interceptor.	• CSO 007 is relocated, not eliminated. • Long-term maintenance costs for relocated CSO.	RETAINED
7 New South Interceptor	• CSO 007 is eliminated. • Provides redundancy for existing interceptor.	• *Highest construction cost.* • Significant construction disruption from new sewer running through a number of neighborhoods for a long distance.	ELIMINATED

Table 6-3. Preliminary Screening of Southside Alternatives			
Alternative	**Advantages**	**Disadvantages**	**Screening Result**
8a New Relief Sewer from Franciscan & Relocation of CSO 007	• *Second lowest construction cost.*	• CSO 007 is relocated, not eliminated. • Construction disruption from new sewer running through a number of neighborhoods for a long distance. • Long-term maintenance costs for relocated CSO. • Long-term maintenance costs for new pump station.	RETAINED
8b Increased Treatment at Franciscan & Relocation of CSO 007	• *Construction cost is less than 10% more than the second lowest cost alternative.*	• Discharges more wet weather flow (receiving primary treatment and disinfection) to Black Hawk Creek. • CSO 007 is relocated, not eliminated. • Long-term maintenance costs for relocated CSO. • Long-term maintenance costs for new pump station.	ELIMINATED
8c New Relief Sewer from Saukie & Franciscan	• *Construction cost is less than 10% more than the second lowest cost alternative.* • CSO 007 is eliminated.	• Significant construction disruption from new sewer running through a number of neighborhoods for a long distance. • Long-term maintenance costs for two new pump stations.	RETAINED

Table 6-3. Preliminary Screening of Southside Alternatives			
Alternative	**Advantages**	**Disadvantages**	**Screening Result**
8d Increased Treatment at Saukie & Franciscan	• CSO 007 is eliminated.	• *Construction cost is over 25% more than the second lowest cost alternative.* • Discharges more wet weather flow (receiving primary treatment and disinfection) to Black Hawk Creek. • Long-term maintenance costs for two new pump stations.	ELIMINATED

6.10 SUMMARY OF ALTERNATIVES SELECTED FOR DETAILED ANALYSIS

Seven alternatives (3-4 for each the north and south sides of the City) were selected for detailed analysis based on the criteria discussed in Section 3.0 and the screening shown above. The Water Resources Advisory Committee was presented with the alternatives and concurred with the alternative selection. None of the eliminated alternatives provided a significantly greater environmental benefit than the alternatives that were retained.

The alternatives selected for the northside are

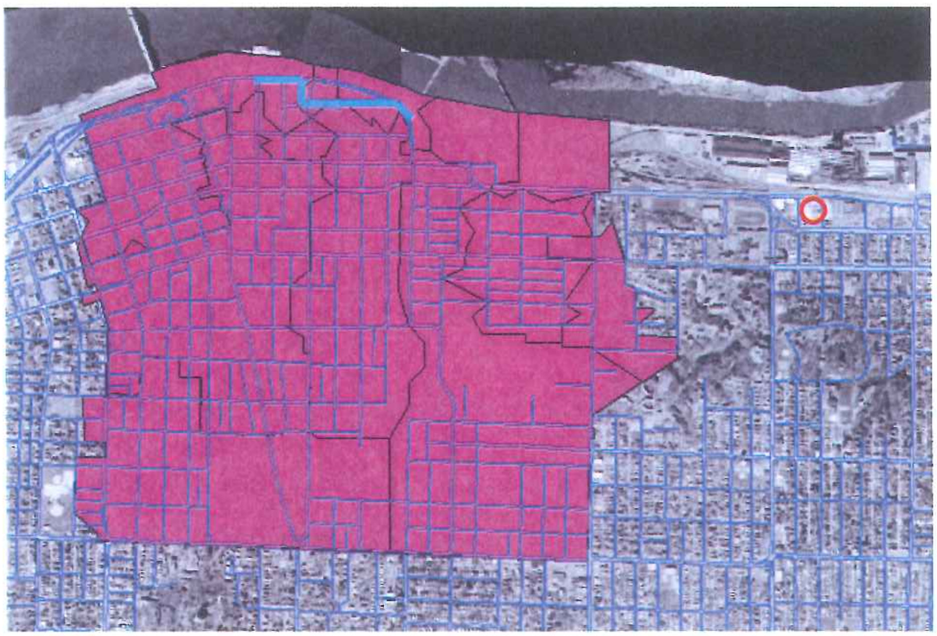
- Alternative 1a – Partial Separation
- Alternative 2a – New Pumped North Interceptor,
- Alternative 3 – New Northside Relief Sewer,
- and Alternative 4b – New Pumped Interceptor to New CSO West of Centennial Bridge.

The selected alternatives for the southside are

- Alternative 6b – Increased Conveyance Around BHLS & Relocation of CSO 007,
- Alternative 8a – New Relief Sewer from Franciscan & Relocation of CSO 007,
- and Alternative 8c – New Relief Sewer from Saukie and Franciscan.

Further details on each of these alternatives are provided above. These alternatives will be further refined and analyzed to select one final recommended plan for improving Rock Island's CSO control problems. The results of this in-depth analysis will be documented in the *Analysis of Alternative Control Technologies & Recommended Control Plan Technical Memorandum*, which is due to the USEPA on April 6, 2006.

Figure 1. Alternative 1a (Northside Partial Separation) Conveyance Layout

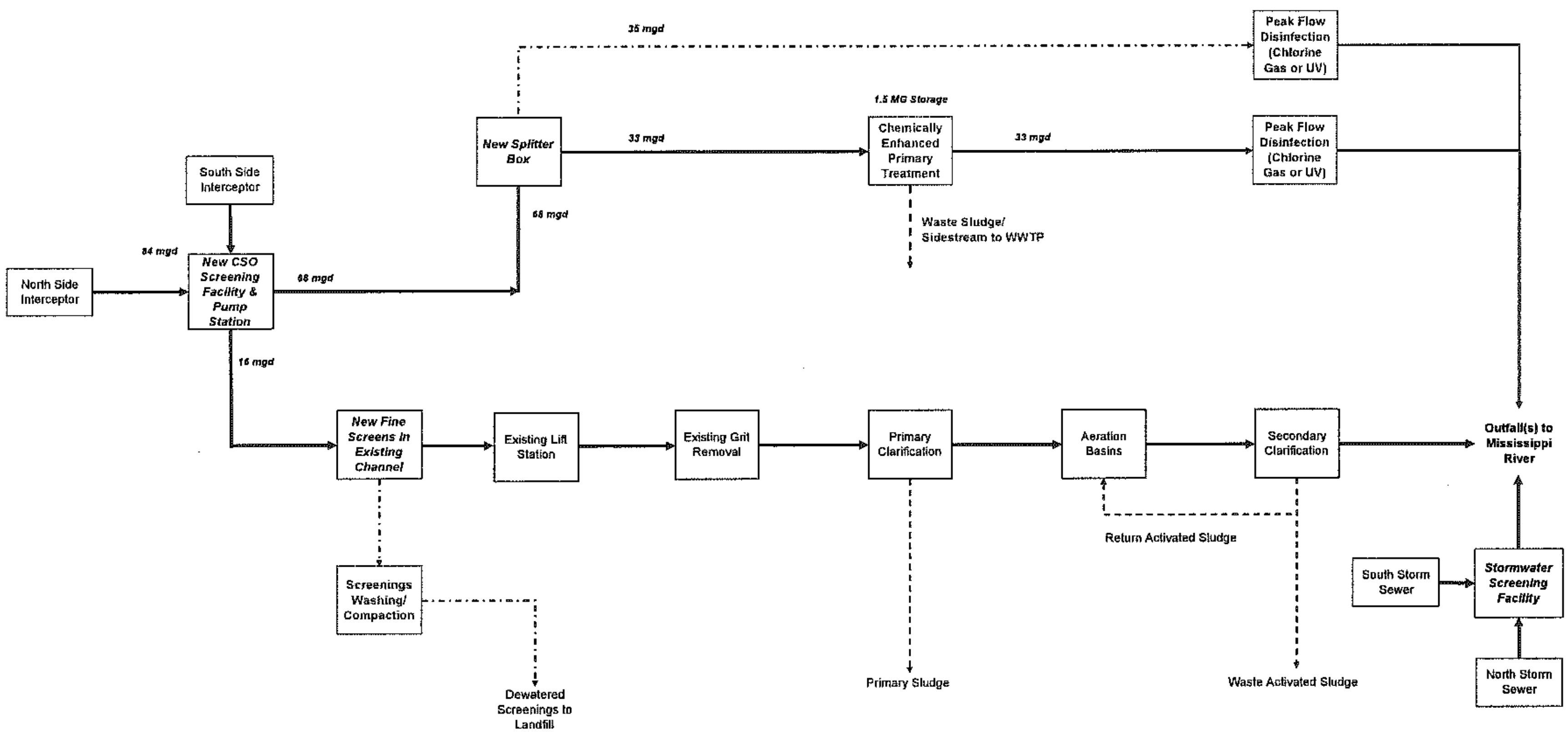


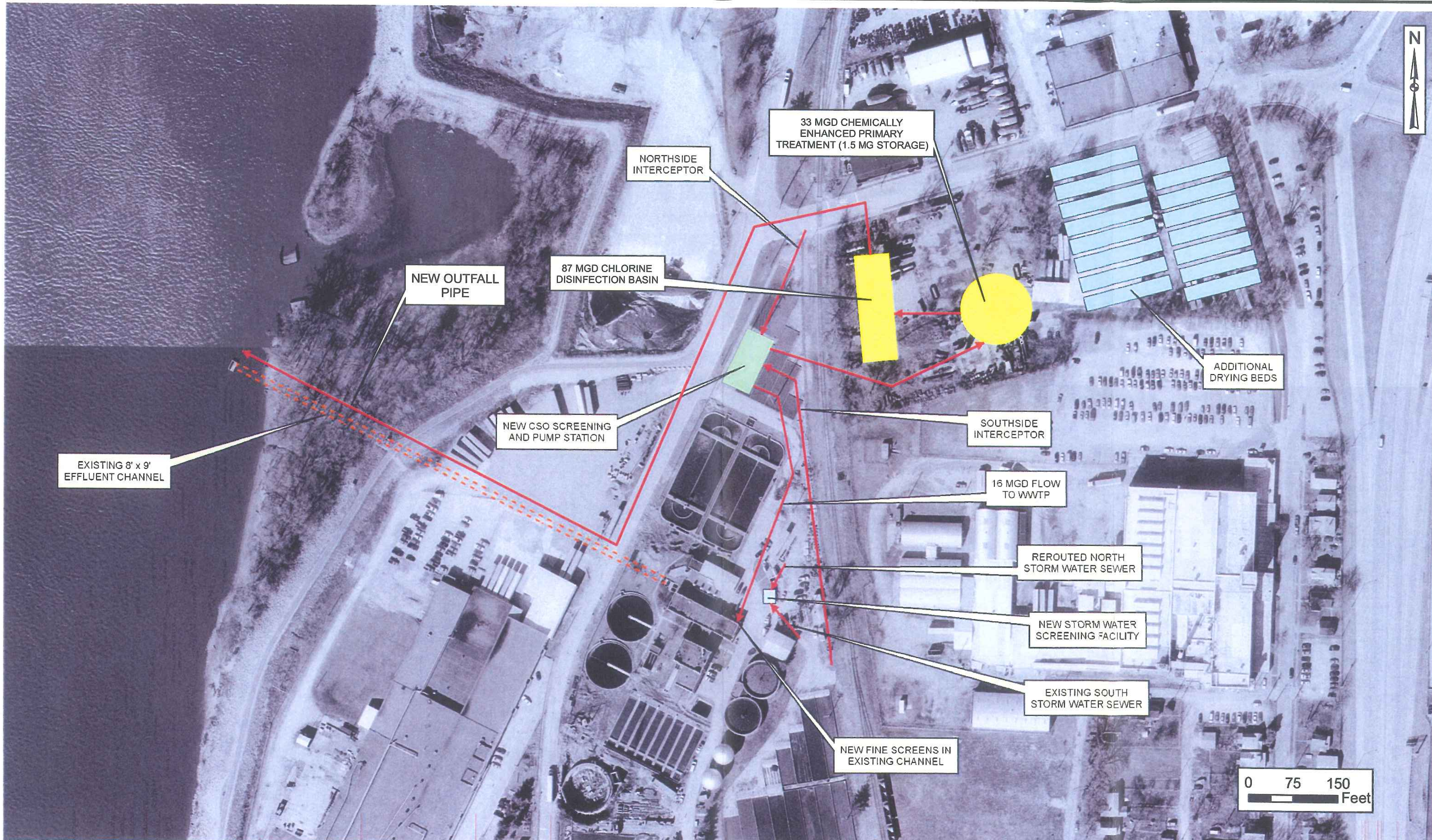
LEGEND

new gravity sewer | new pump station | new storage tank | new force main

new high rate treatment, screening and/or disinfection | areas of sewer separation

Figure 2. WWTP Schematic for Alternative 1a.





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- WATER SUPPLY AND DISTRIBUTION
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- PROCESS ENGINEERING
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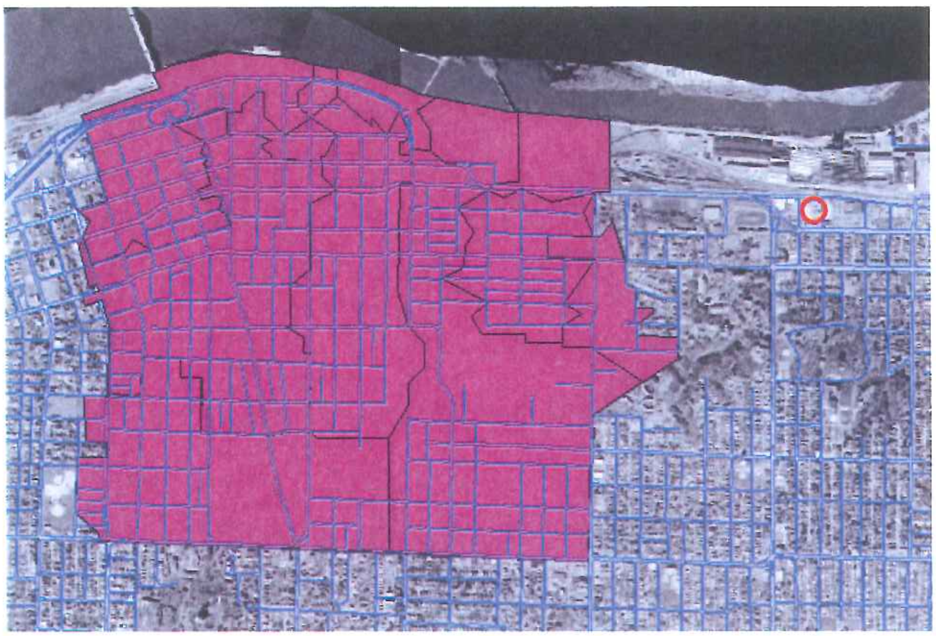
FIGURE 3
WWTP LAYOUT FOR ALTERNATIVE 1A

SCALE	1 inch equals 150 feet
DWG	04-W041106
DATE	MAR 2006
PROJ NO.	W041106

Figure 4. Alternative 1b (Northside Full Separation) Conveyance Layout

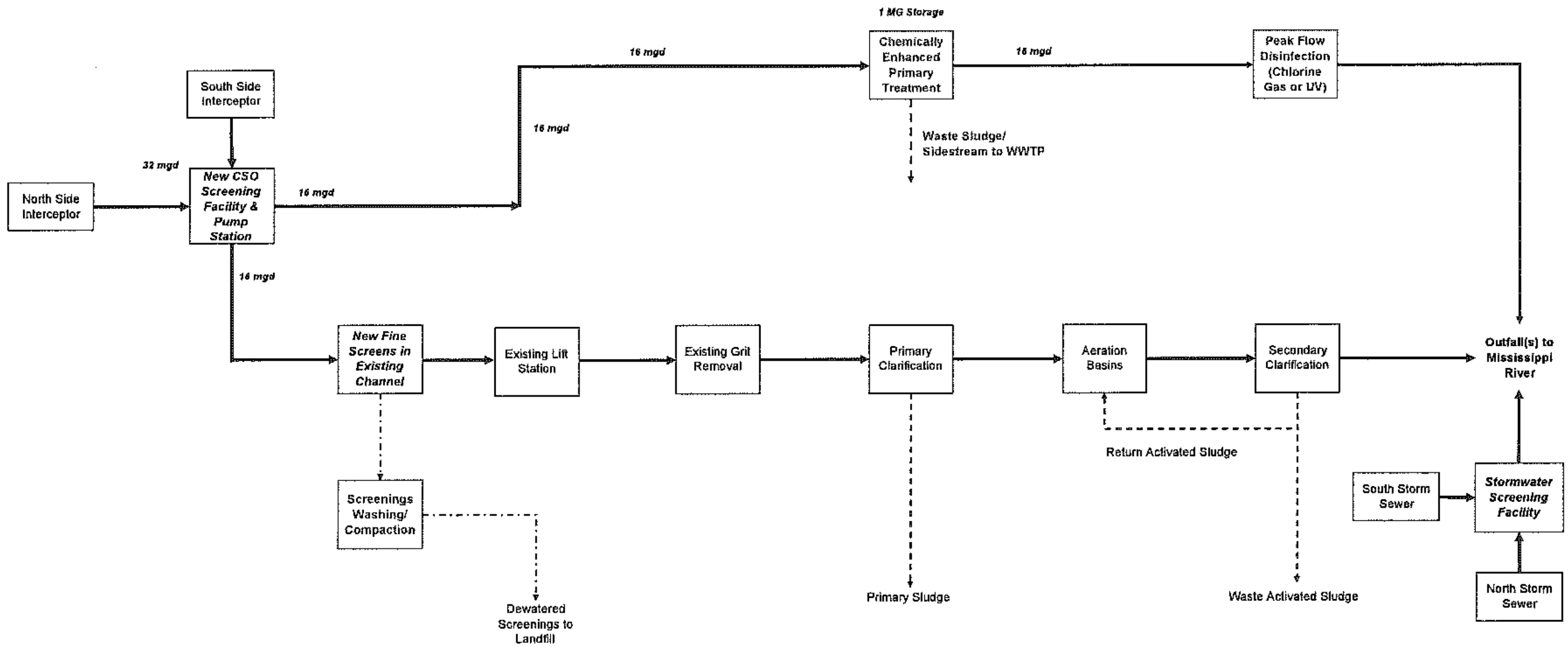


LEGEND

new gravity sewer | new pump station | new storage tank | new force main

new high rate treatment, screening and/or disinfection | areas of sewer separation

Figure 5. WWTP Schematic for Alternative 1b.



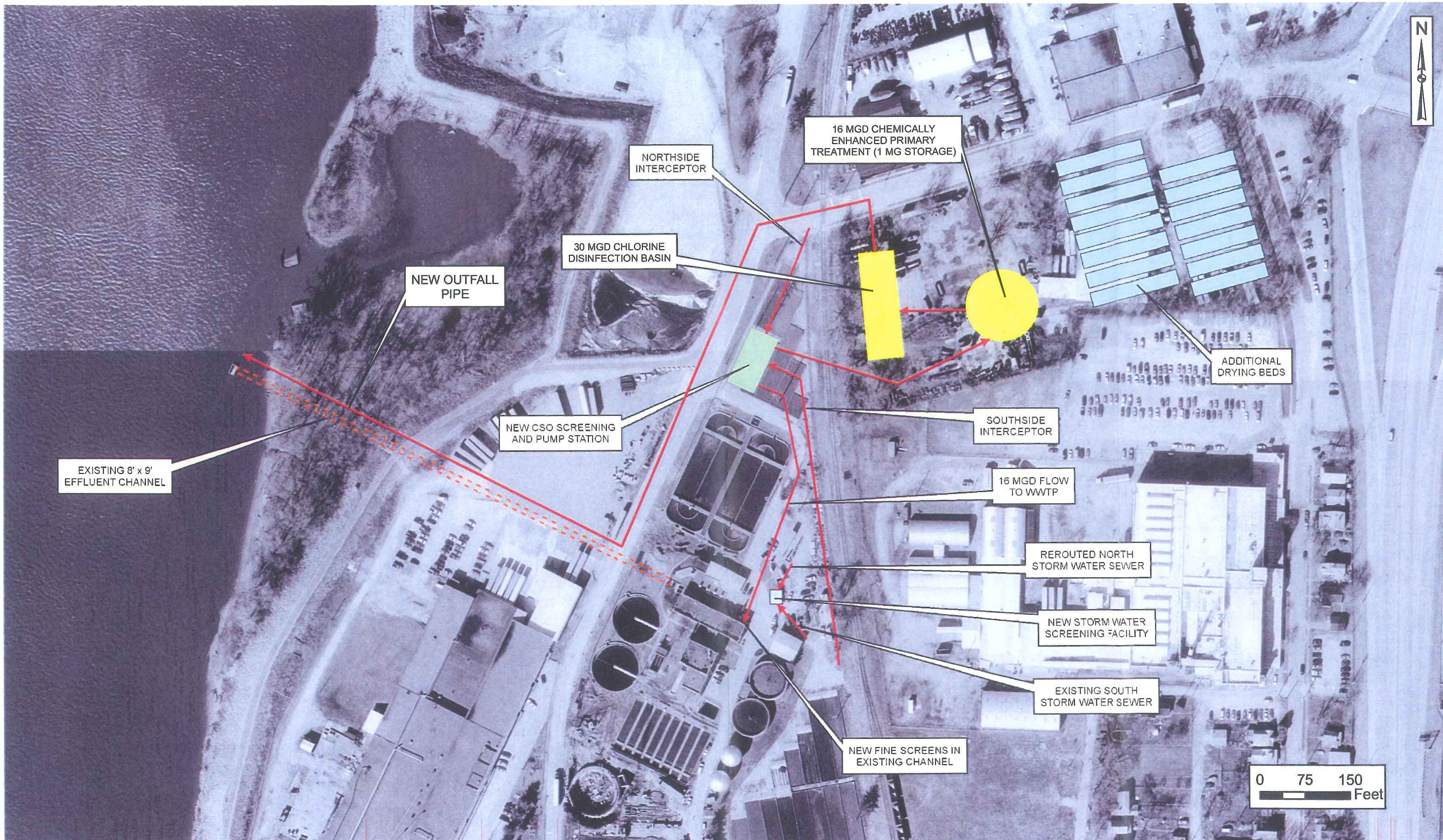


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FIGURE 6
WWTP LAYOUT FOR
ALTERNATIVE 1B

SCALE	1 inch equals 150 feet
DWG	04-W041106
DATE	MAR 2006
PROJ NO.	W041106

Figure 7. Alternative 2a (New Gravity North Interceptor) Conveyance Layout

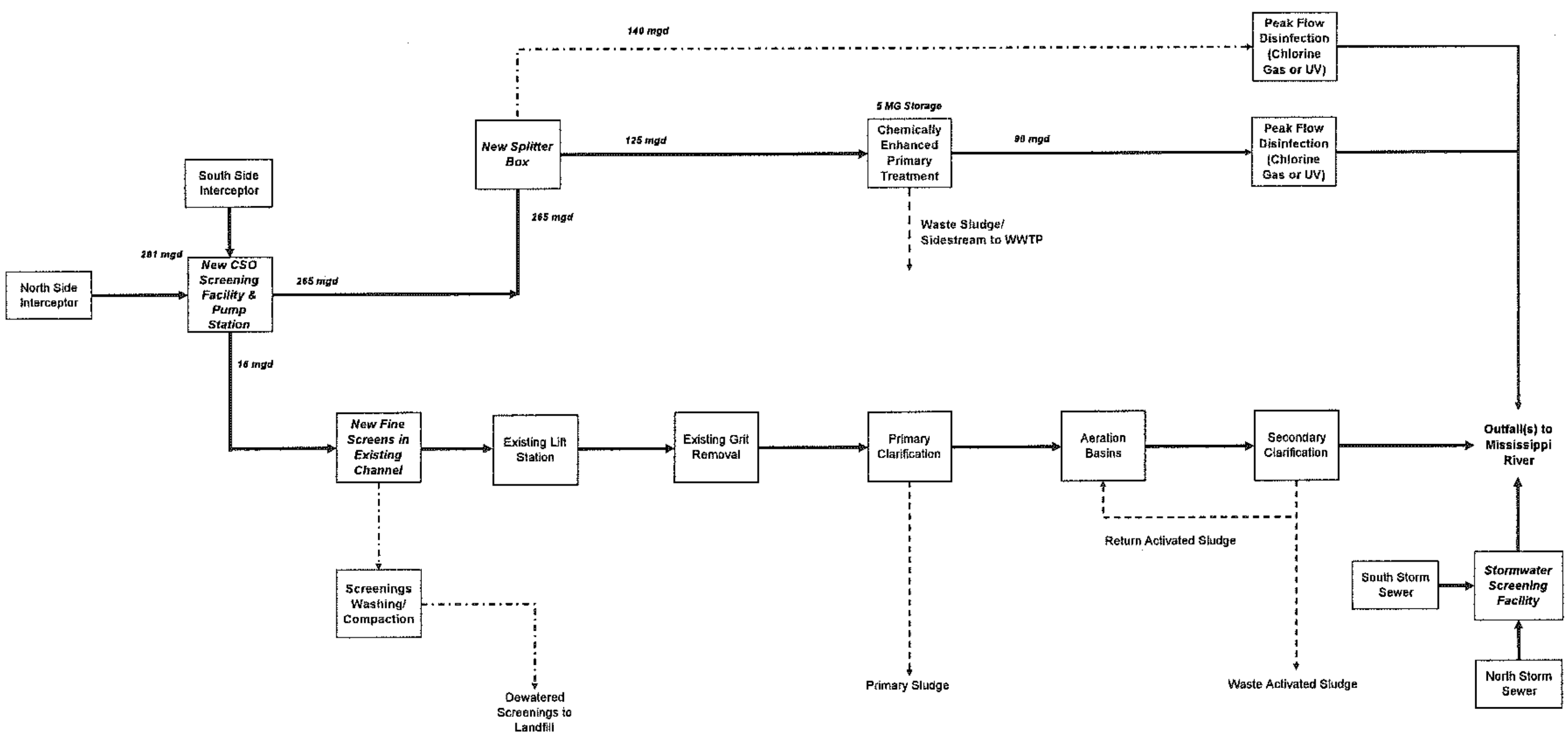
LEGEND

new gravity sewer
new pump station
new storage tank
new force main
new high rate treatment, screening and/or disinfection
areas of sewer separation

Figure 8. Alternative 2b (New Pumped North Interceptor) Conveyance Layout

Figure 9. Alternative 3 (New Relief Sewer Along 6th Avenue) Conveyance Layout

Figure 10. WWTP Schematic for Alternatives 2a, 2b and 3.



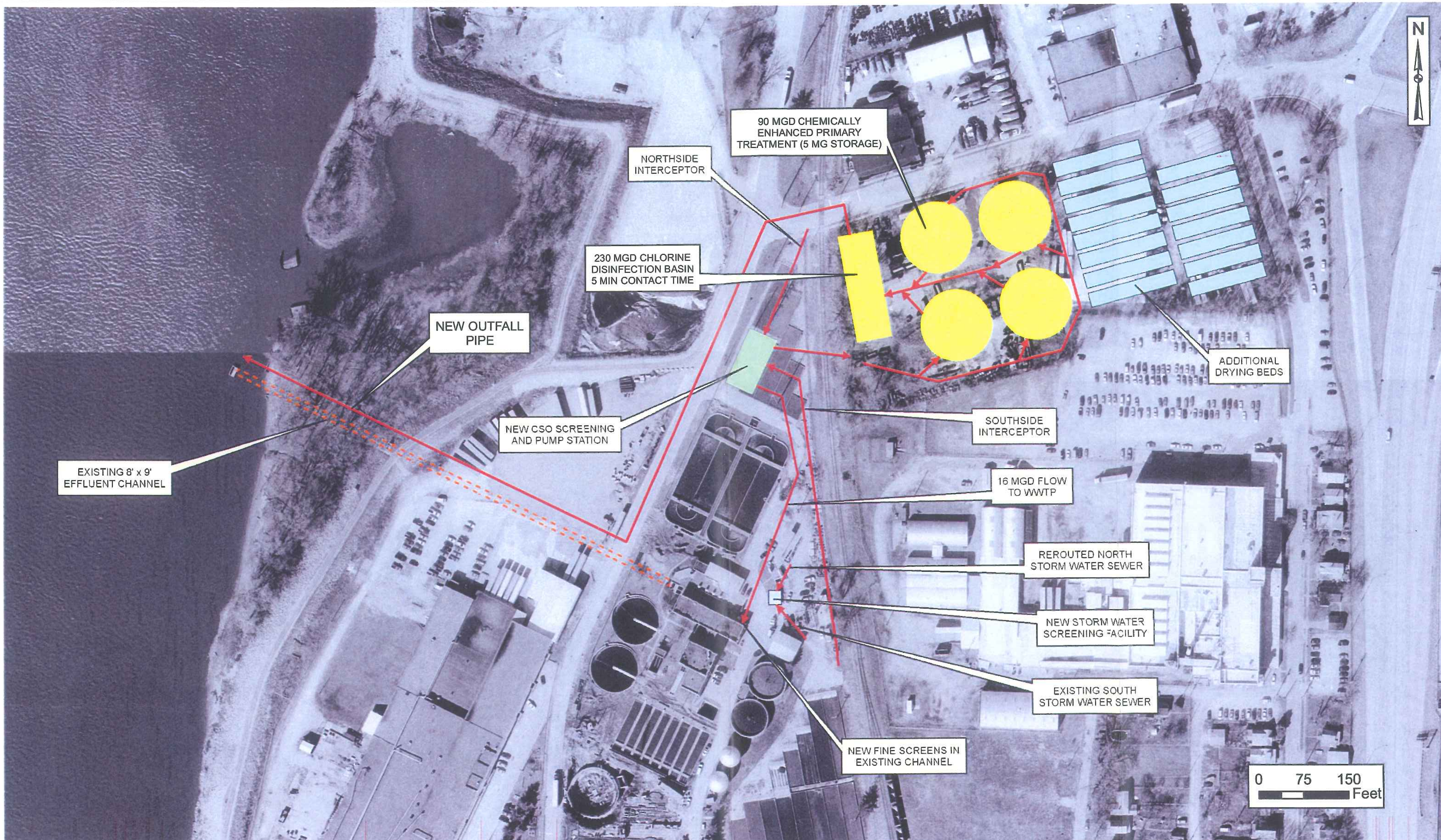


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FIGURE 11
WWTP LAYOUT FOR
ALTERNATIVES 2A, 2B, AND 3

SCALE	1 inch equals 150 feet
DWG	04-W041106
DATE	MAR 2006
PROJ NO.	W041106

Figure 12. Alternative 4a (New Gravity North Interceptor to New CSO) Conveyance Layout

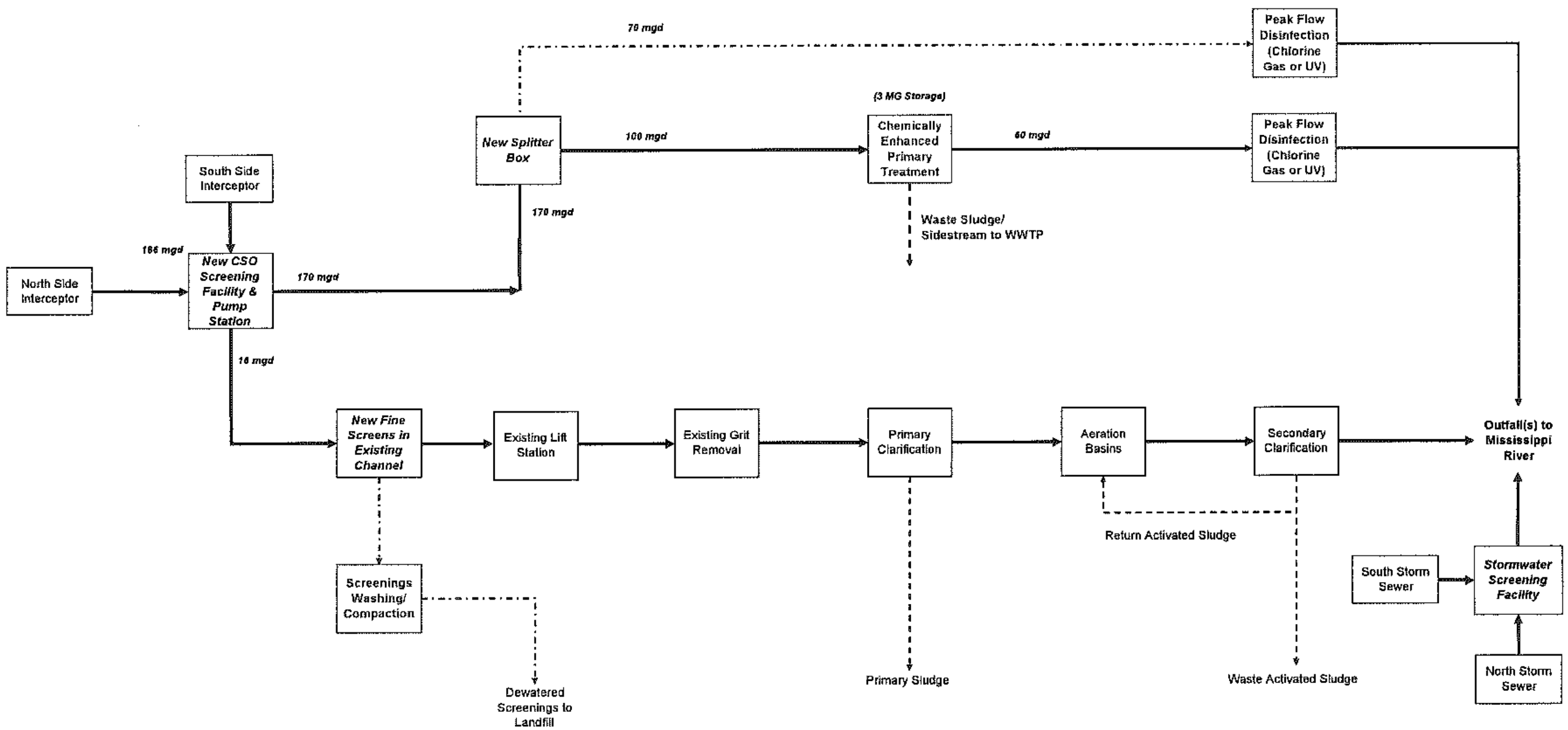
Figure 13. Alternative 4b (New Pumped North Interceptor to New CSO) Conveyance Layout

LEGEND

new gravity sewer — new pump station — new storage tank — new force main

new high rate treatment, screening and/or disinfection — areas of sewer separation

Figure 14. WWTP Schematic for Alternatives 4a and 4b.



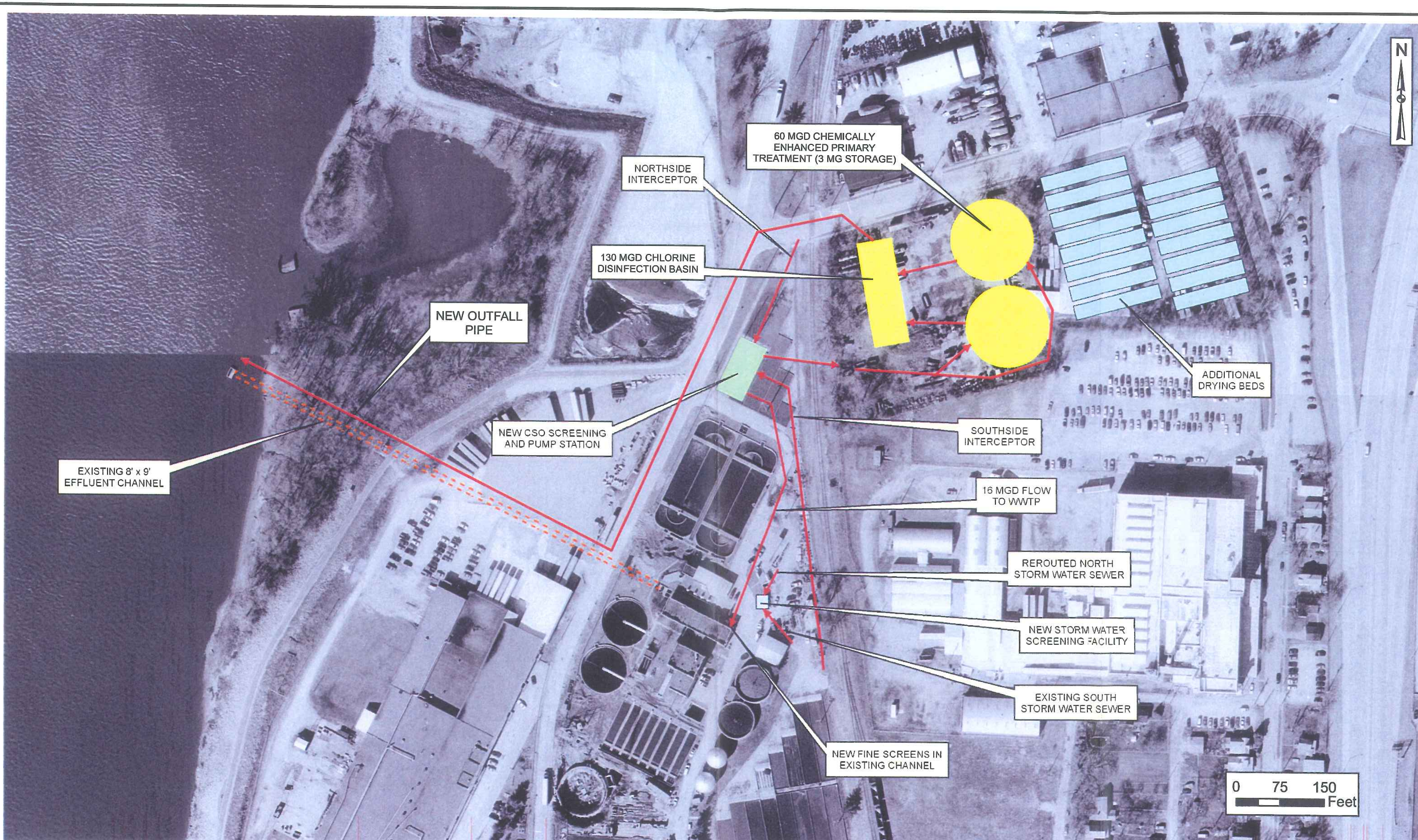


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FIGURE 15
WWTP LAYOUT FOR
ALTERNATIVES 4A AND 4B

SCALE	1 inch equals 150 feet
DWG	04-W041106
DATE	MAR 2006
PROJ NO.	W041106

Figure 16. Alternative 5 (Southside Source Control) Conveyance Layout

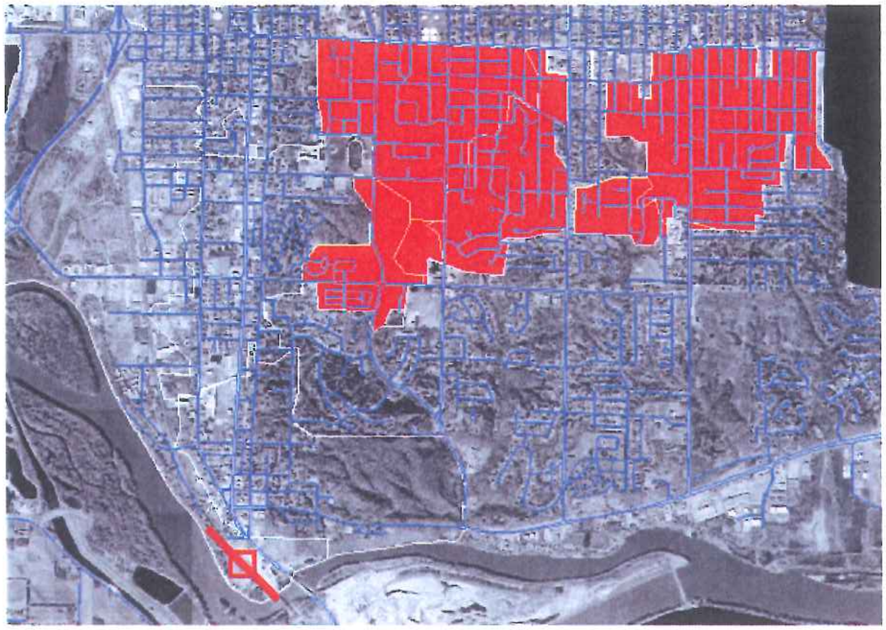

Figure 17. Alternative 6a (New Storage Tank & Relocation of CSO 007) Conveyance Layout

LEGEND

new gravity sewer   new pump station   new storage tank   new force main

new high rate treatment, screening and/or disinfection   areas of sewer separation

Figure 18. Alternative 6b (Increased Conveyance Around BHLS & Relocation of CSO 007) Conveyance Layout

Figure 19. Alternative 7 (New South Interceptor) Conveyance Layout

LEGEND

new gravity sewer | new pump station | new storage tank | new force main

new high rate treatment, screening and/or disinfection | areas of sewer separation

Figure 20. Alternative 8a (New Relief Sewer from Franciscan & Relocation of CSO 007) Conveyance Layout

Figure 21. Alternative 8b (Increased Treatment at Franciscan & Relocation of CSO 007) Conveyance Layout

LEGEND

new gravity sewer | new pump station | new storage tank | new force main

new high rate treatment, screening and/or disinfection | areas of sewer separation

Figure 22. Alternative 8c (New Relief Sewer from Saukie & Franciscan) Conveyance Layout

Figure 23. Alternative 8d (Increased Treatment at Saukie & Franciscan) Conveyance Layout

LEGEND

new gravity sewer — new pump station — new storage tank — new force main

new high rate treatment, screening and/or disinfection — areas of sewer separation

Appendix

COMBINED SEWER OVERFLOW EVENT DETERMINATION MEMO AND FOLLOW-UP CORRESPONDENCE

TRIAD ENGINEERING INCORPORATED

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MEMORANDUM

TO: Kevin Chow, U.S. Environmental Protection Agency, Region 5
Tobey Frevert, Illinois Environmental Protection Agency

FROM: Brandon Koltz

DATE: June 17, 2005

SUBJECT: Combined Sewer Overflow Event Determination
Rock Island Combined Sewer Overflow Long Term Control Plan
Civil Action No: 4:00-CV004076

COPIES: Tom Andryk, Illinois Environmental Protection Agency
Thomas Davis, Esq., Illinois Attorney General's Office
Robert Hawes, City of Rock Island
Roy Harsch, Esq., Gardner, Carton & Douglas
John Konecky, Esq., Konecky, Koenig & Terronz
Dale Howard, City of Rock Island
Chief, Environmental Enforcement Section, U.S. Department of Justice
Gerald Brost, United States Attorney's Office
Chief, Water Enforcement and Compliance Assurance Branch, U.S. Environmental Protection Agency, Region 5
Yvonne Ciccone, SAIC

This memorandum addresses the issue of CSO event determination brought forth during the April 6, 2005 meeting between the City of Rock Island and the Illinois Environmental Protection Agencies. Regulatory agency concurrence with the proposal suggested in this memorandum is critical to the development of Rock Island's Long Term Control Plan.

In creating their Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP), the City of Rock Island has chosen to use the presumption approach. According to the United States Environmental Protection Agency (EPA) CSO Control Policy, the presumption approach can be used if controls adopted in the LTCP allow for

> *no more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year. For the purpose of this criterion, an overflow event is one or more overflows from a CSO as the result of a precipitation event that does not receive the minimum treatment specified*[1].

Clearly being able to define and count overflow events is crucial to using this approach. Currently there is no standard method for event counting. The key issue for counting

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[1] CSO Control Policy, 59 *Federal Register* 18688, April 19, 1994

overflow events revolves around selecting the minimum duration of the dry period between events. This is known as the inter-event period.

The City's current NPDES Permit (No. IL 0030783) dictates that a 24-hour inter-event period be used to report overflows. It states that "for frequency reporting [of CSOs], all discharges from the same storm, or occurring within 24 hours, shall be reported as one." Triad proposes using the same 24-hour inter-event period for determining if the CSO control projects being considered for the LTCP meet the presumption approach.

To verify that a 24-hour inter-event period is appropriate for CSO control planning purposes, Triad analyzed the characteristics of overflow Outfall 001. We selected this outfall because it has the greatest overflow frequency, volume, and duration. All other outfalls have a shorter duration of overflow.

Figure 1 (a through k) presents a time series plot from April 1, 2002 to December 30, 2004 showing hourly rainfall depth[2]. It also shows whether an overflow was happening at CSO 001.

To examine the validity of the 24-hour inter-CSO event period, Triad performed a statistical analysis on the overflow and rainfall data shown in Figure 1. The statistical analysis focused on identifying the maximum duration of overflow response to a rainfall. The inter-event period is often set equal to the maximum response duration.

From April 1, 2002 to December 30, 2004, CSO 001 overflowed for a total of 694 hours. Figure 2 illustrates the number of CSO hours recorded versus the time since the most recent rainfall during normal and high stage. Nearly one-half of all overflow hours occurred while it was raining (zero hours since most recent rainfall occurred). The number of overflow hours decreases quickly once the rainfall ceases. For example, over 50 overflow hours occurred at least one hour after rainfall stopped while only eight occurred 7 hours after rainfall stopped.

The gap in the high river stage graph of Figure 2, between 32 and 39 hours (since the most recent rainfall occurred), is related to the 5/13/02 – 5/15/02 overflow event. During this event, CSO 001 stopped overflowing 30 hours after the rainfall stopped (at 1:00 AM on 5/15/02) and then started overflowing again 9 hours later without any additional precipitation occurring. The overflow most likely stopped due to a decrease in dry weather flow that typically occurs during the night. Figure 3 shows the average metered diurnal fluctuation in dry weather flow in the City of Rock Island. Between the hours of 1:00 AM and 10:00 AM the dry weather flow is below the average daily dry weather flow. This drop in flow, starting at 1:00 AM, was probably significant enough to cause the overflow on 5/15/02 to stop until the dry weather increased again at 10:00 AM.

---

[2] The City of Rock Island commenced continuous monitoring of CSO at Outfall 001 on April 1, 2002. No data are available prior to this date.

As shown in both Figures 1 and 2, after a number of rainfall events overflow continues for many hours before ceasing. In certain cases, the overflow continues for days. From Figure 2 it is clear that overflow duration in excess of seven hours only occurs when the Mississippi is at least 5' above its long-term average stage. As documented in the *Collection System Hydraulic Model Technical Memorandum* (December 1, 2004), Rock Island experiences substantial infiltration from the river during high river stage. When the river stage reaches 16 to 17 feet, the dry weather flow rate approaches the capacity of the Mill Street WWTP. During high river stage, the available capacity to treat wet weather flow reduces and results in longer overflow durations for the same size precipitation event.

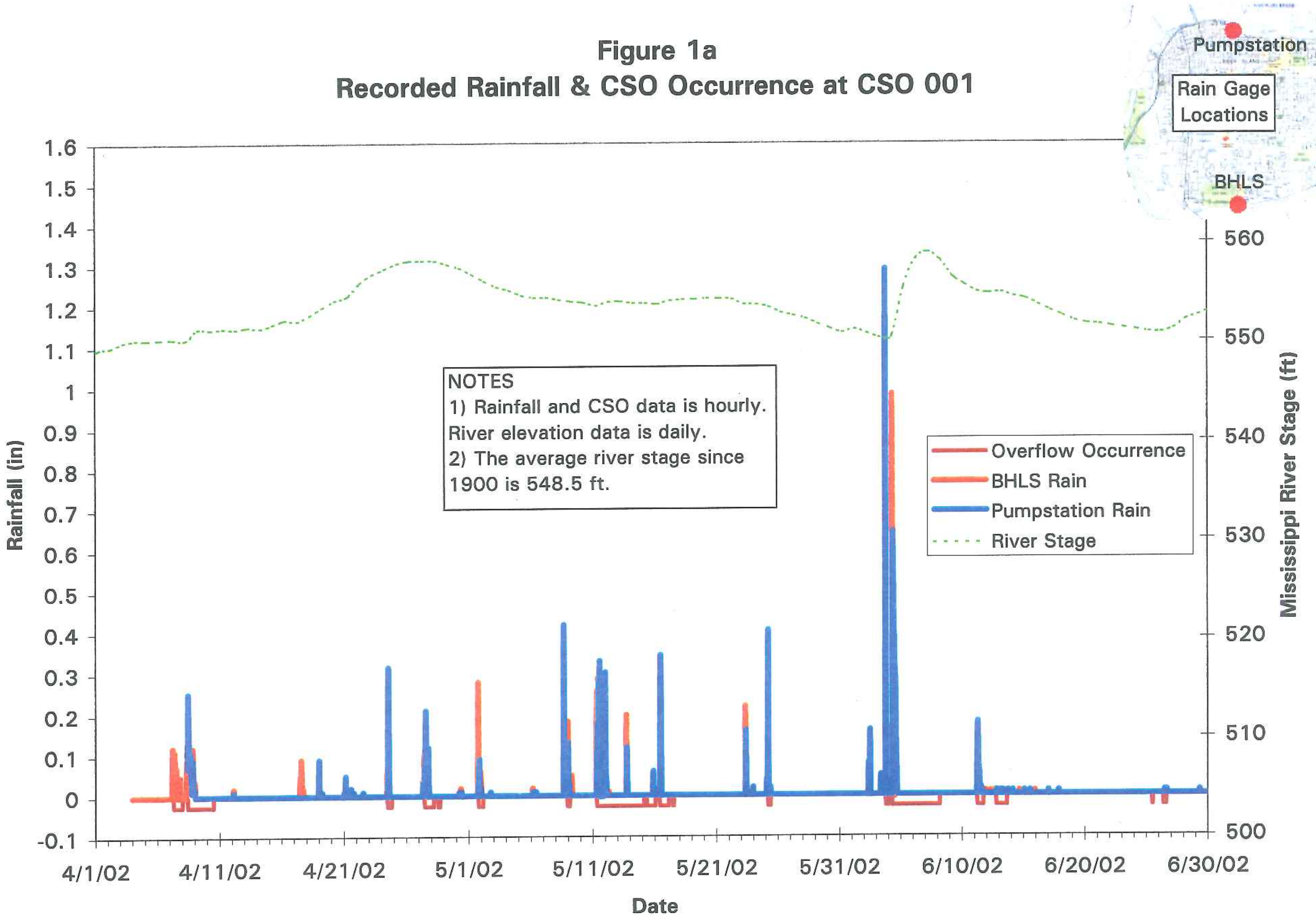
From Figure 2, there is little evidence that rainfall will cause any CSO activity more than 82 hours after the cessation of rainfall when the river stage is high or more than 7 hours after the cessation of rainfall when the river stage is normal. Considering that overflows appear to occur during high river stage less than 50% of the time, it would be unrealistic to set the inter-event period equal to the maximum response duration during high river stage of 82 hours. A practical duration of influence must lie somewhere between 7 and 82 hours.

The operation of the sewer system is another important factor to take into account when determining the duration of influence that rainfall has on CSO occurrence. The Saukie and Franciscan storage basins in the Rock Island sewer system take about 24 hours to completely drain. Thus, it takes the sewer system a full 24 hours to recover from rain events that are large enough to cause a CSO. Rainfall events occurring during this recovery period might result in a CSO when normally they would not. Since a CSO event in this case would be caused by the previous rainfall event, it should not be counted as a second CSO event, but as part of the previous CSO event. Thus, the CSO inter-event period should be set equal to a minimum of 24 hours.

A 24-hour inter-event period would fall within the 7 to 82 hour duration of influence range determined by the statistical analysis above. Increasing the inter-event period from 24 hours would cause a lower total number of counted overflow events than just using a 24-hour inter-event period because, in general, more individual overflow occurrences would be combined into each counted overflow event. Thus, using a 24-hour inter-event period is more conservative than using a 25 to 82 hour inter-event period for modeling CSO LTCP alternatives for compliance with the presumption approach.

Consequently, Triad believes that the 24-hour inter-event period listed in Rock Island's NPDES permit is appropriate for modeling CSO LTCP alternatives. Triad recommends that the City of Rock Island seek concurrence from the USEPA and the IEPA on the use of a 24-hour CSO inter-event period for counting overflows. Agreement is critical as the City moves forward in developing alternatives designed to meet the requirements of the EPA CSO Control Policy and Rock Island's Consent Decree. Agreement now creates the yardstick by which to measure the performance of the alternatives developed in the Long Term Control Plan. It is critical for the ultimate acceptance and approval of the Long Term Control Plan.

Figure 1a
Recorded Rainfall & CSO Occurrence at CSO 001



T30-D4-W041106.BG103-369-Rainfall & CSO OFs for Interevent Analysis.xls

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Figure 1b
Recorded Rainfall & CSO Occurrence at CSO 001

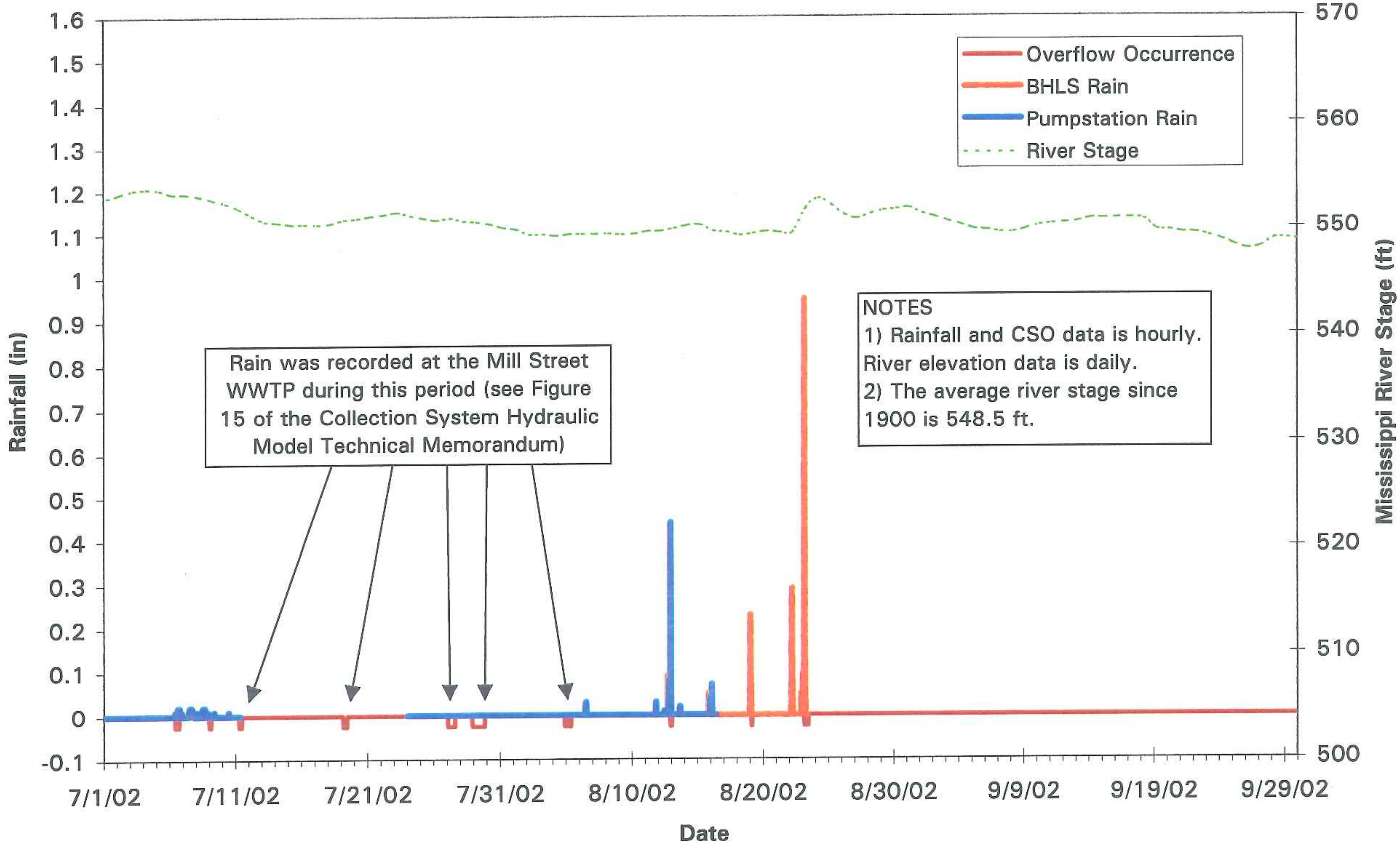

Figure 1c
Recorded Rainfall & CSO Occurrence at CSO 001

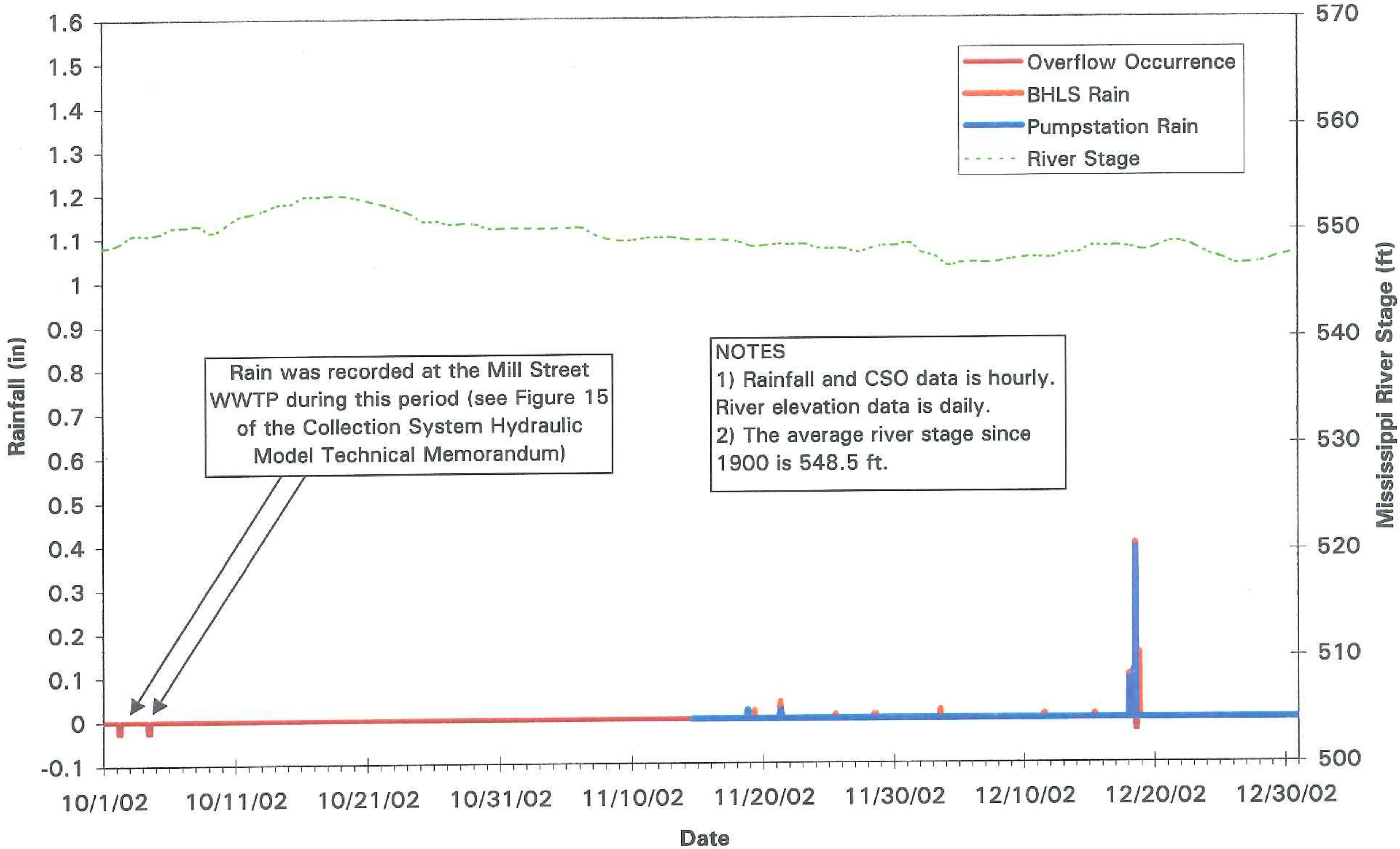

Figure 1d
Recorded Rainfall & CSO Occurrence at CSO 001

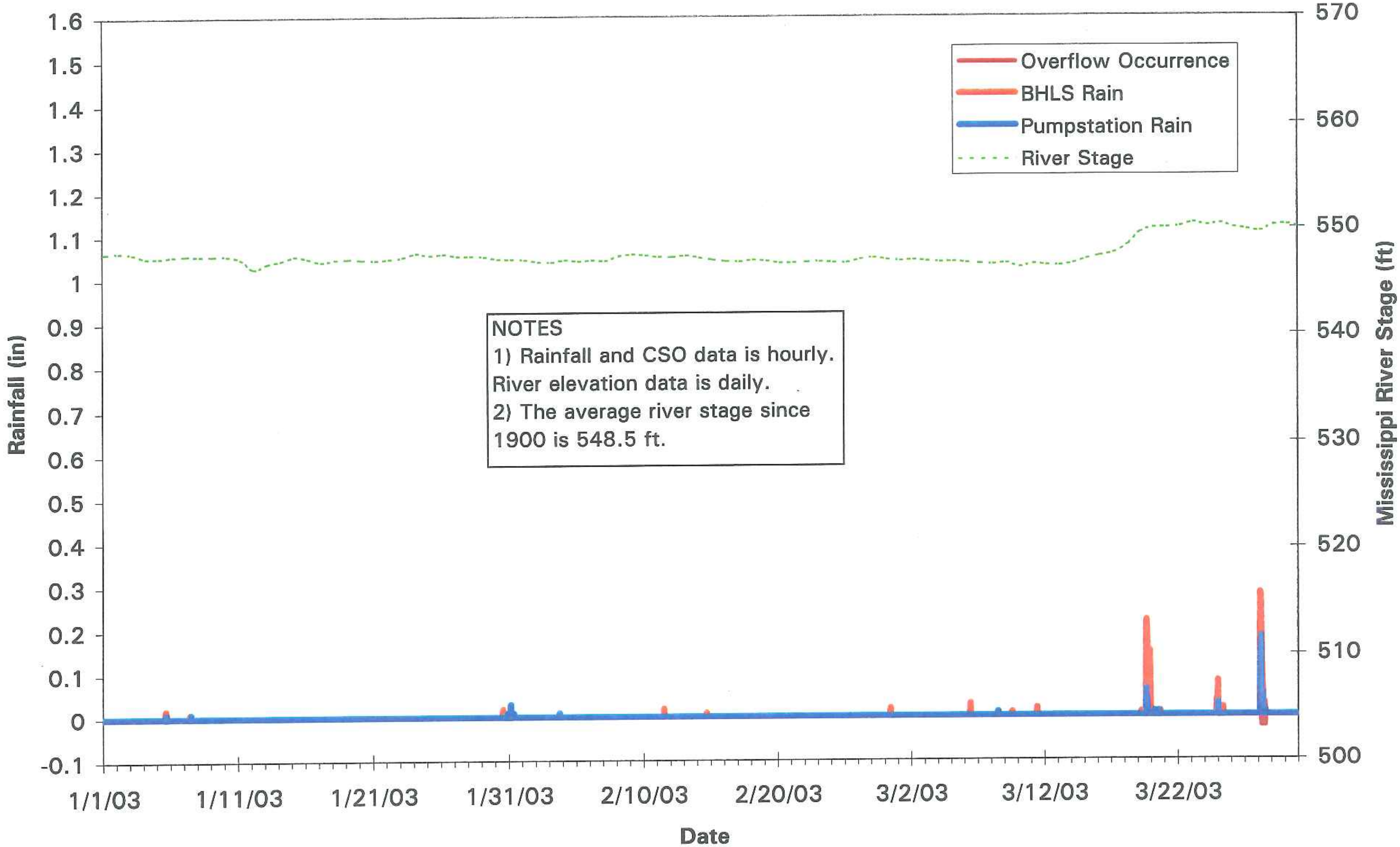

Figure 1e
Recorded Rainfall & CSO Occurrence at CSO 001

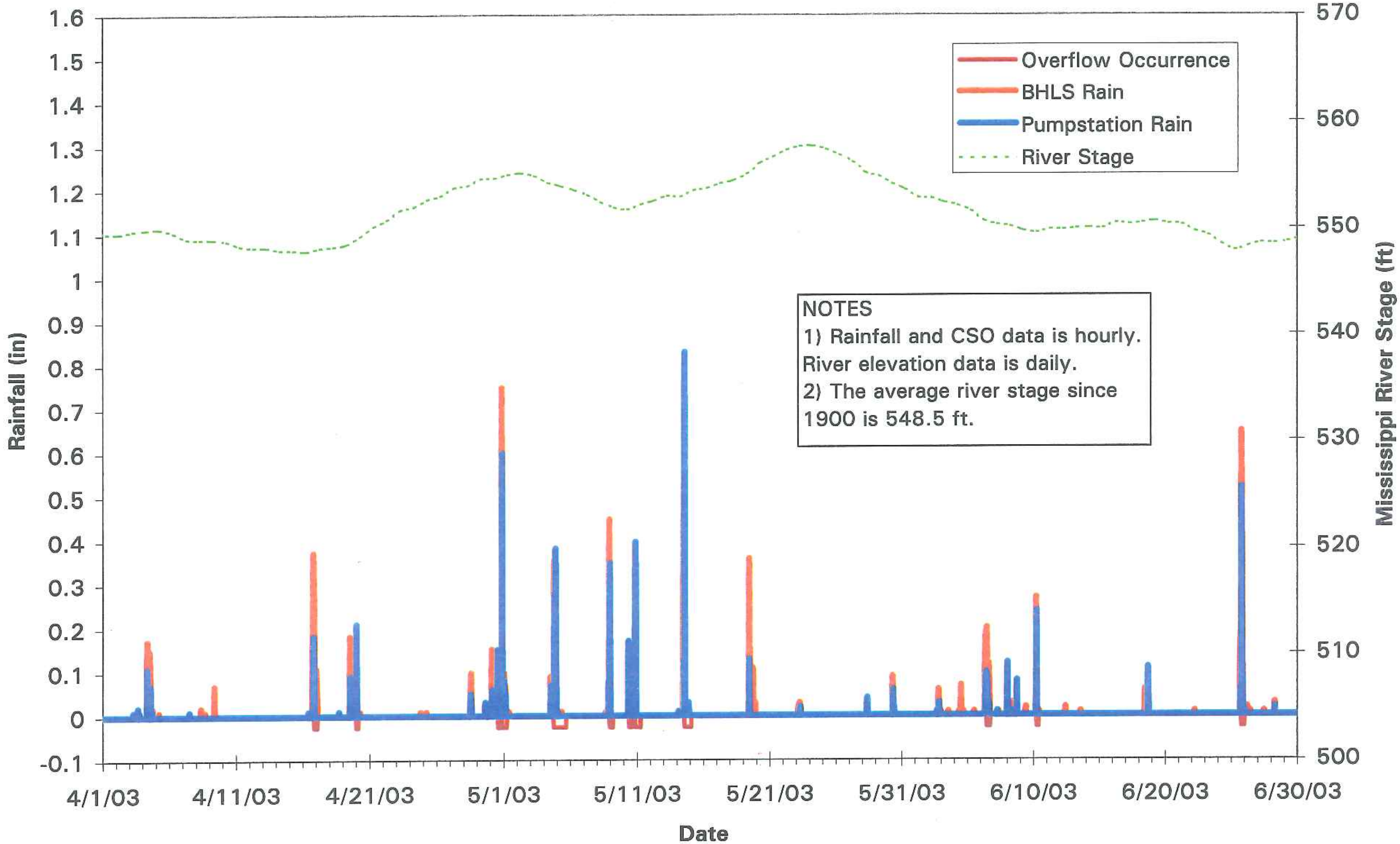

Figure 1f
Recorded Rainfall & CSO Occurrence at CSO 001

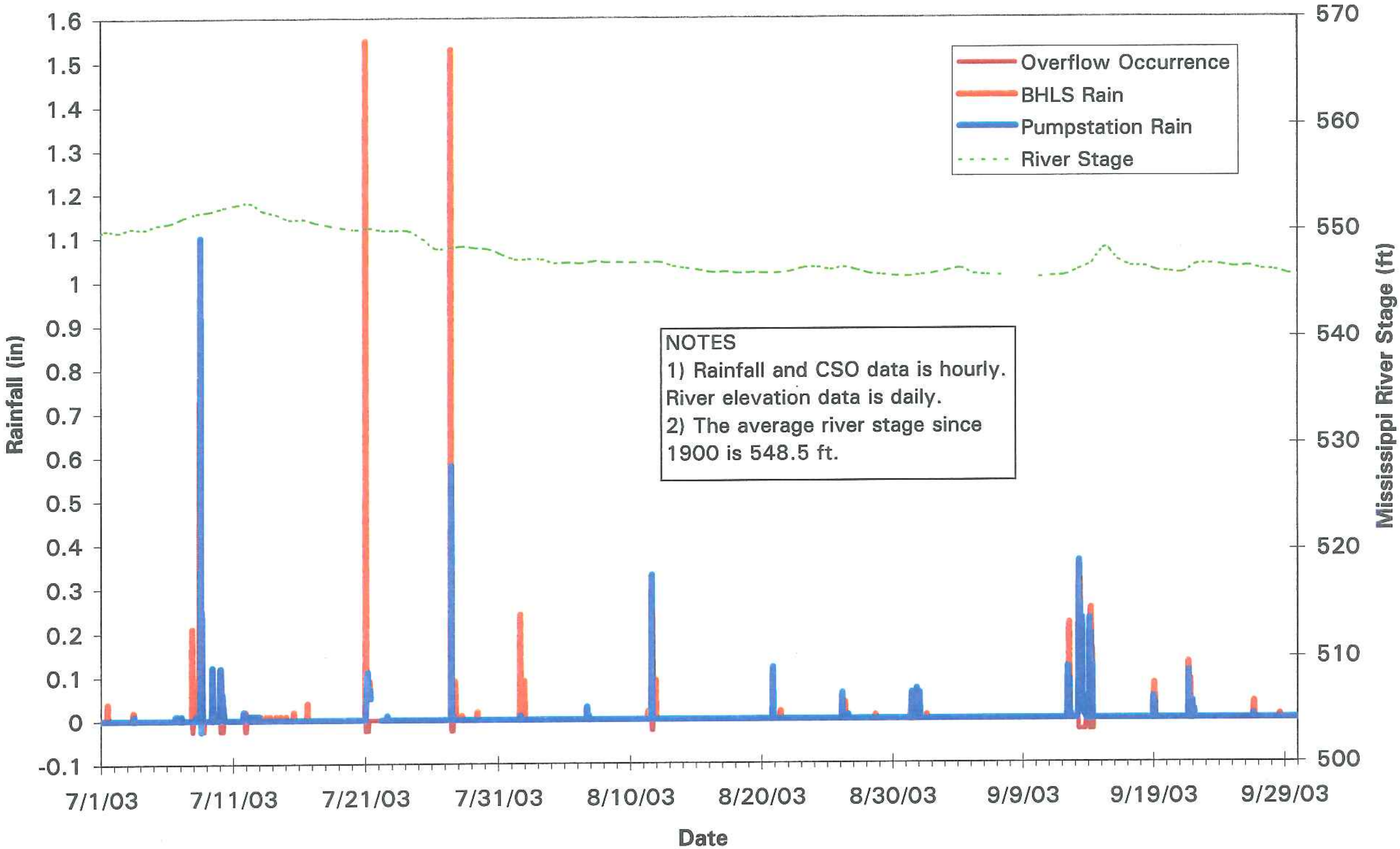

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Figure 1g
Recorded Rainfall & CSO Occurrence at CSO 001

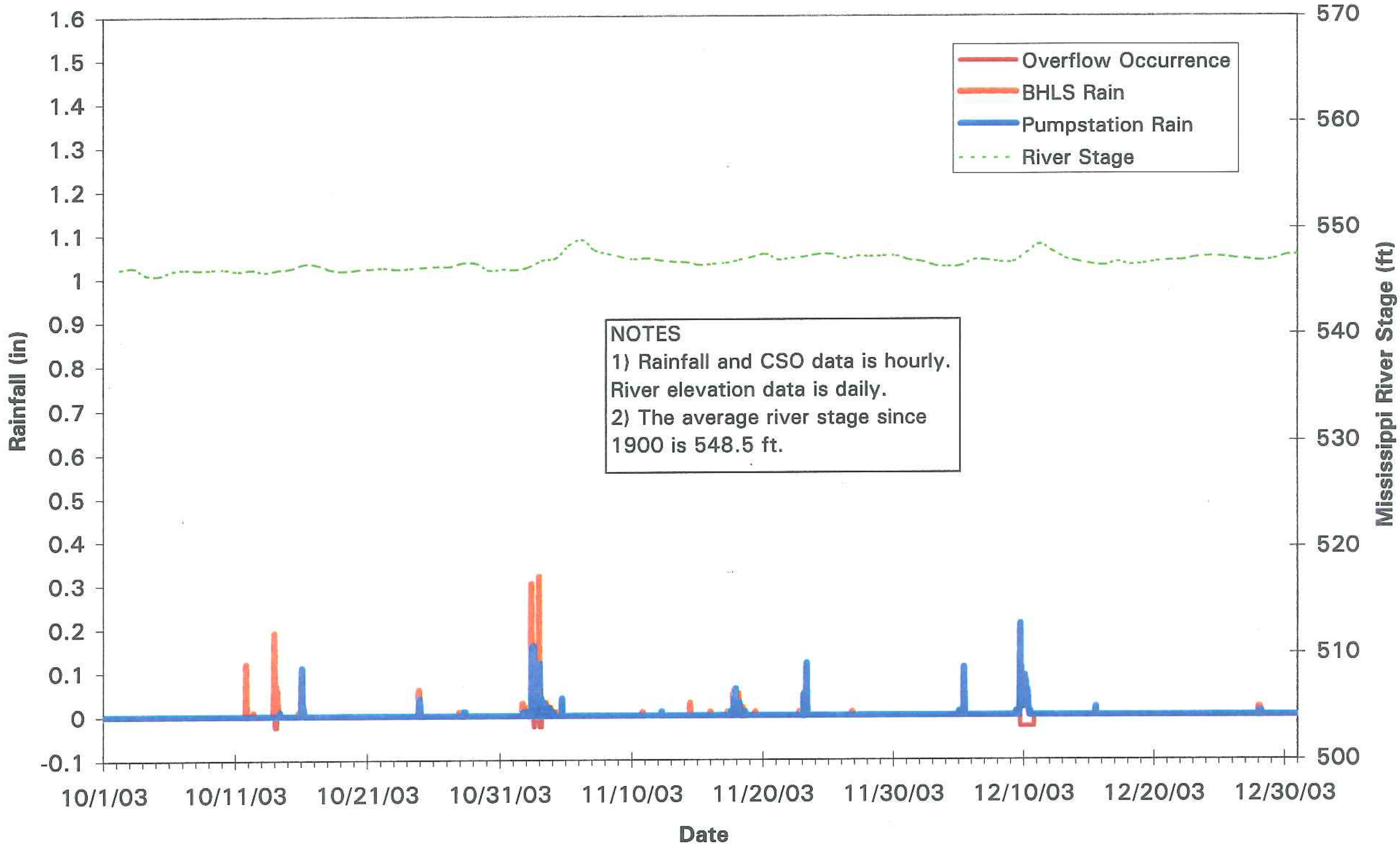

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Figure 1h
Recorded Rainfall & CSO Occurrence at CSO 001

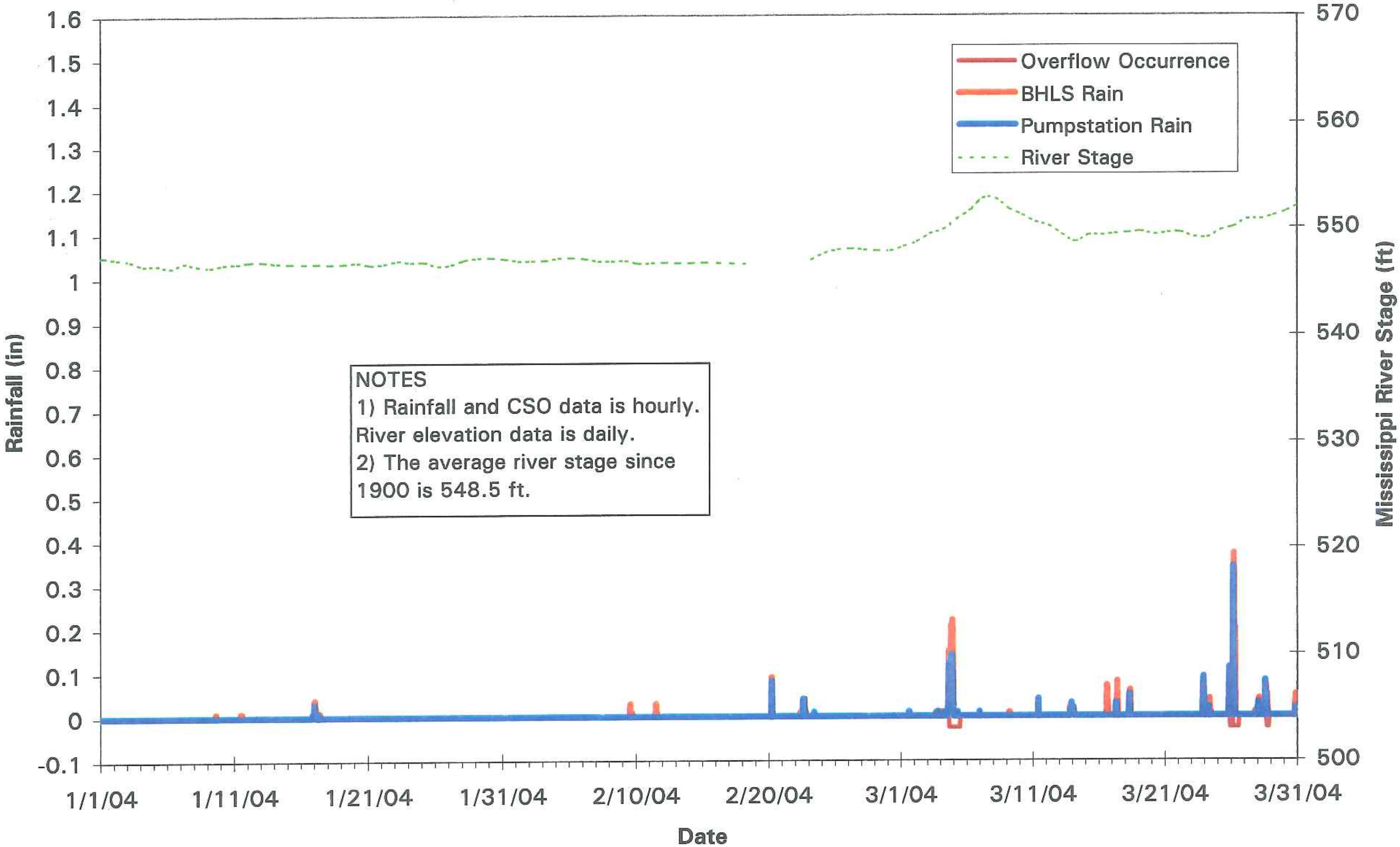
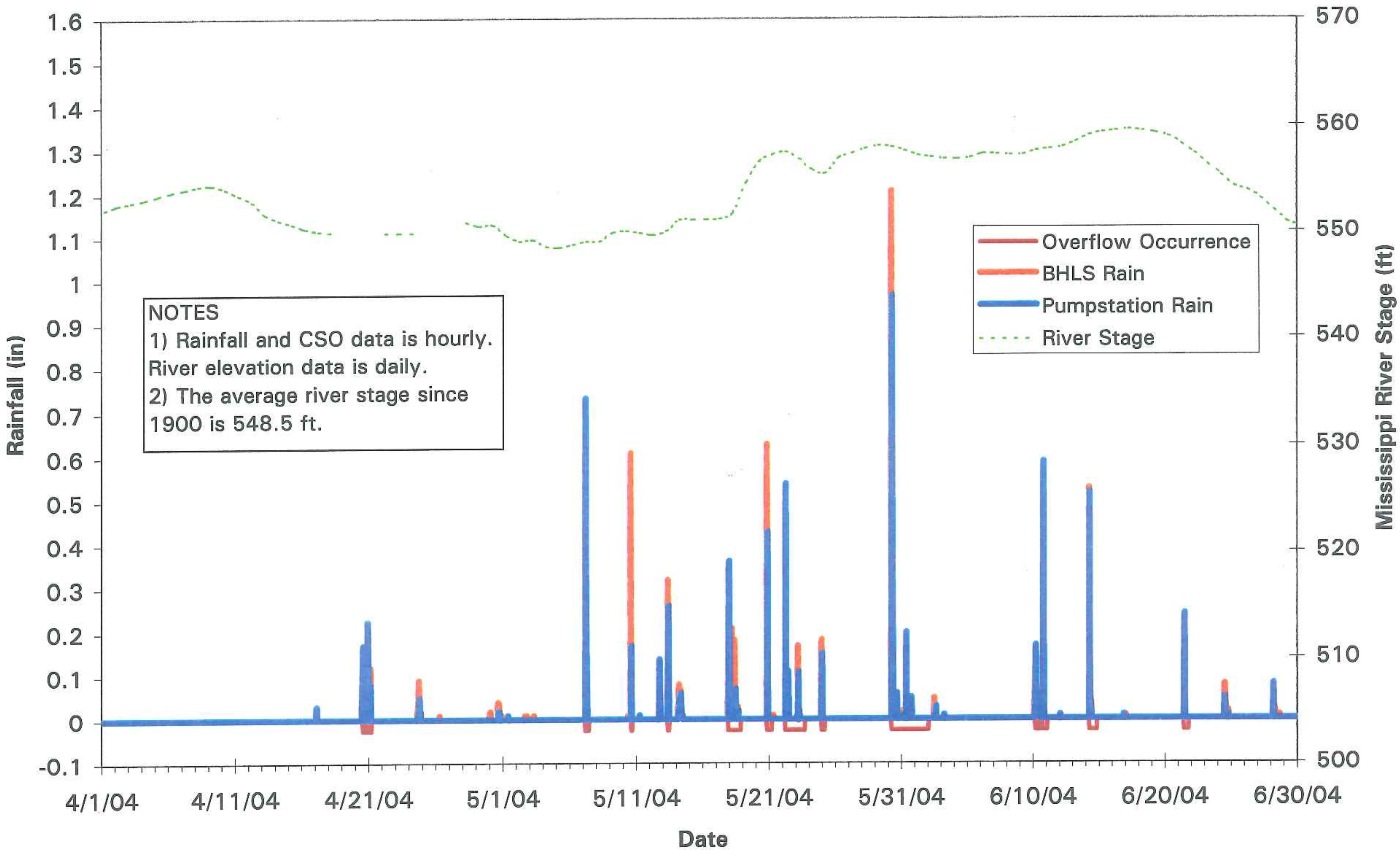


Figure 1i
Recorded Rainfall & CSO Occurrence at CSO 001



T30-D4-W041106.BG103-369-Rainfall & CSO OFs for Interevent Analysis.xls

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Figure 1j
Recorded Rainfall & CSO Occurrence at CSO 001

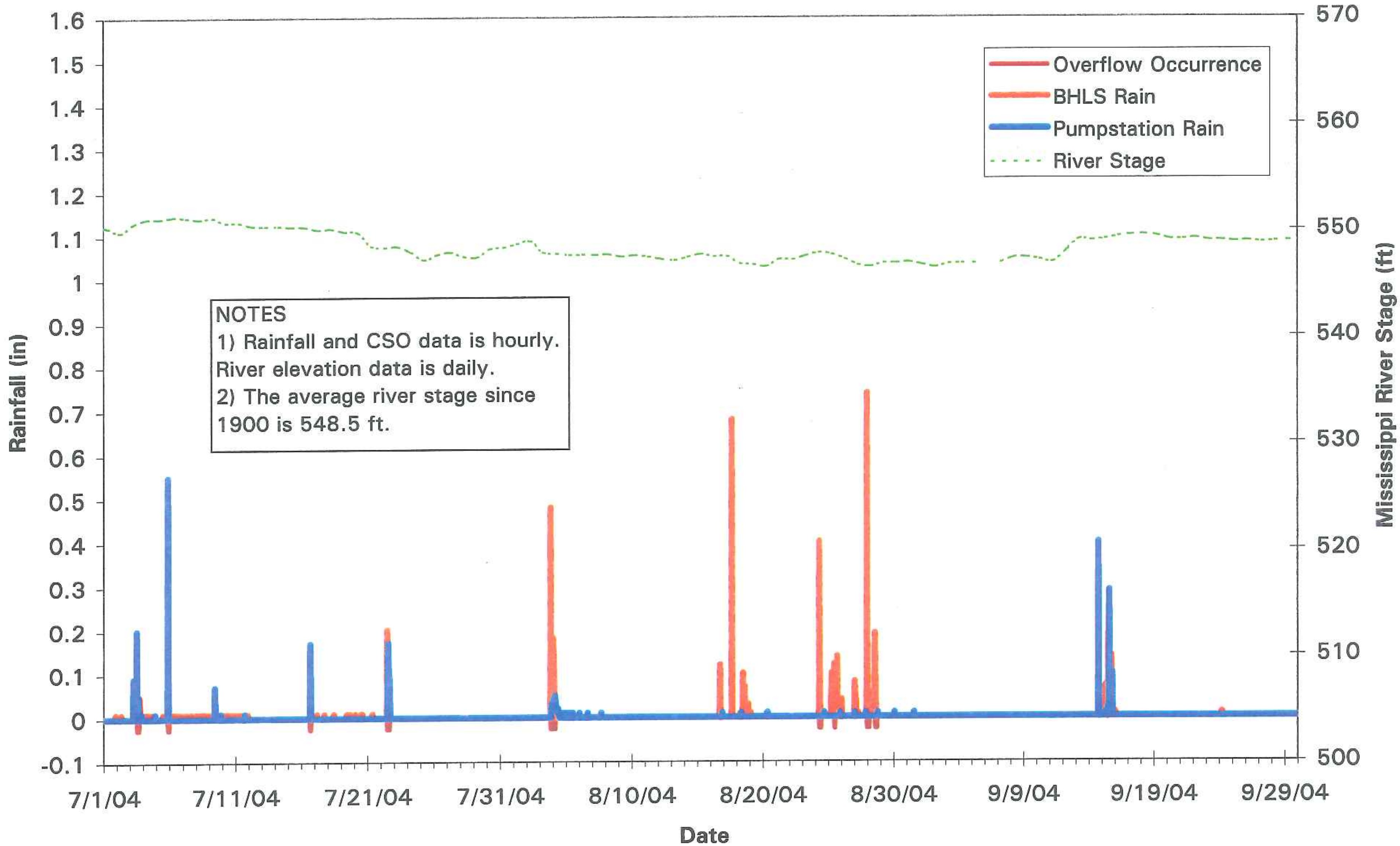

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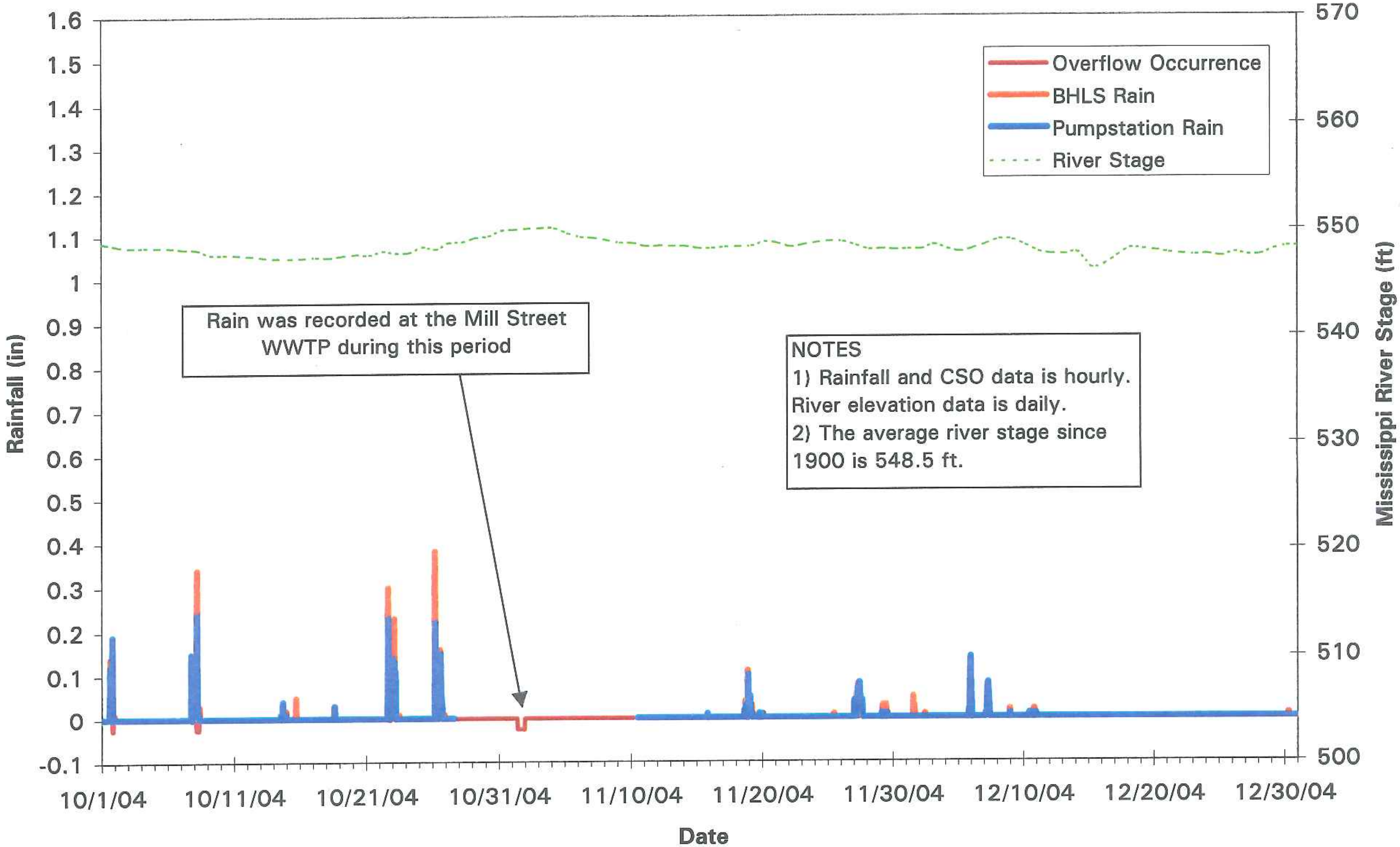
Figure 1k
Recorded Rainfall & CSO Occurrence at CSO 001



T30-D4-W041106.BG103-369-Rainfall & CSO OFs for Interevent Analysis.xls

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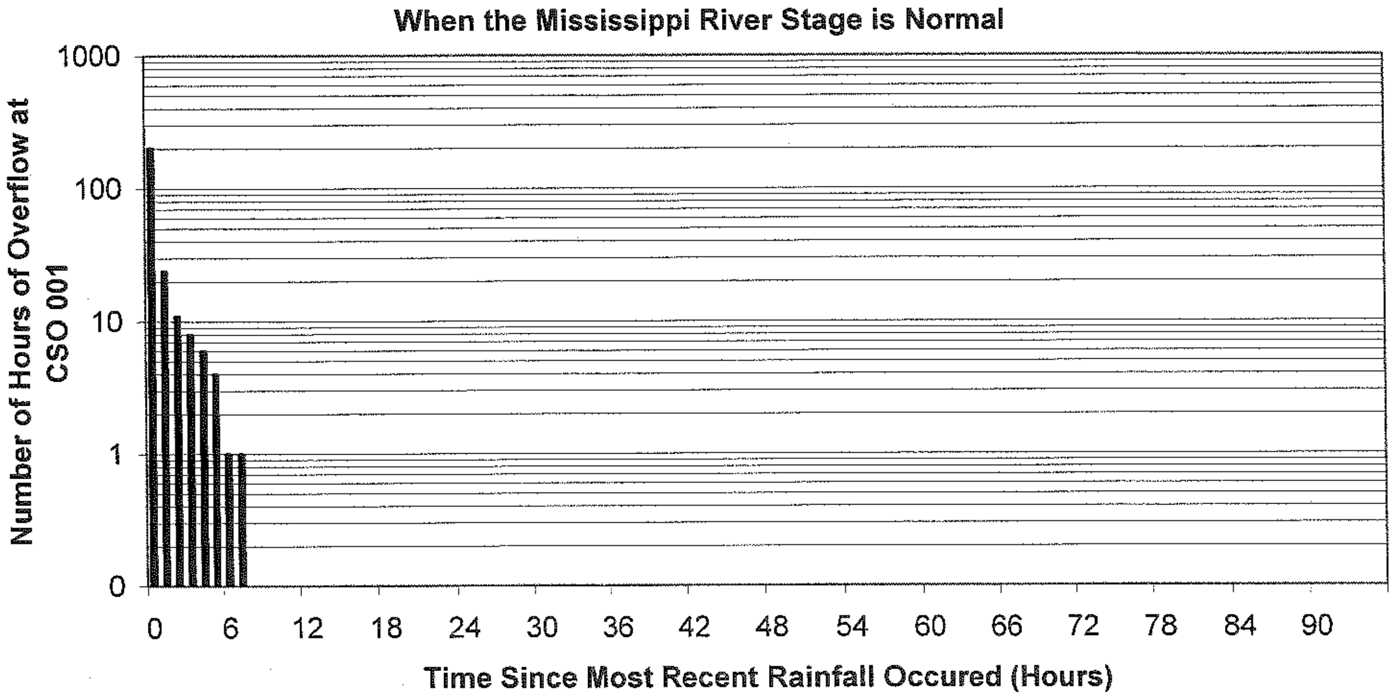
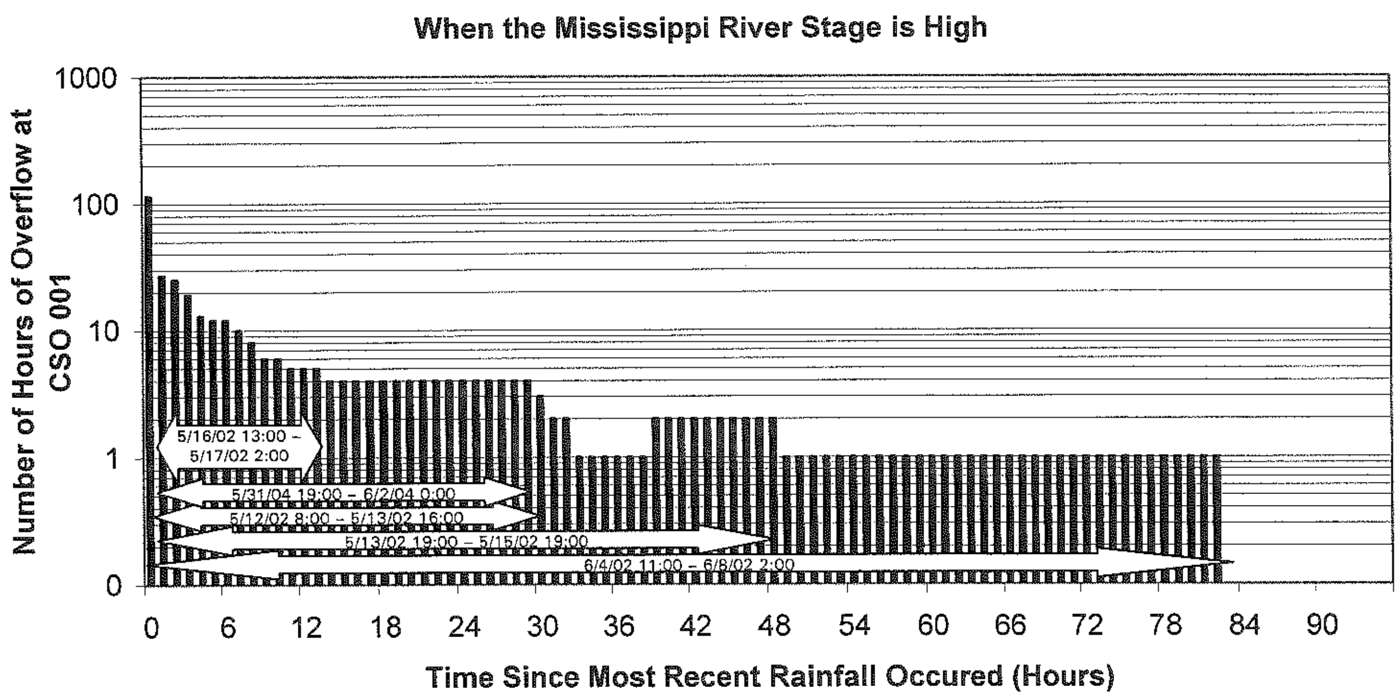
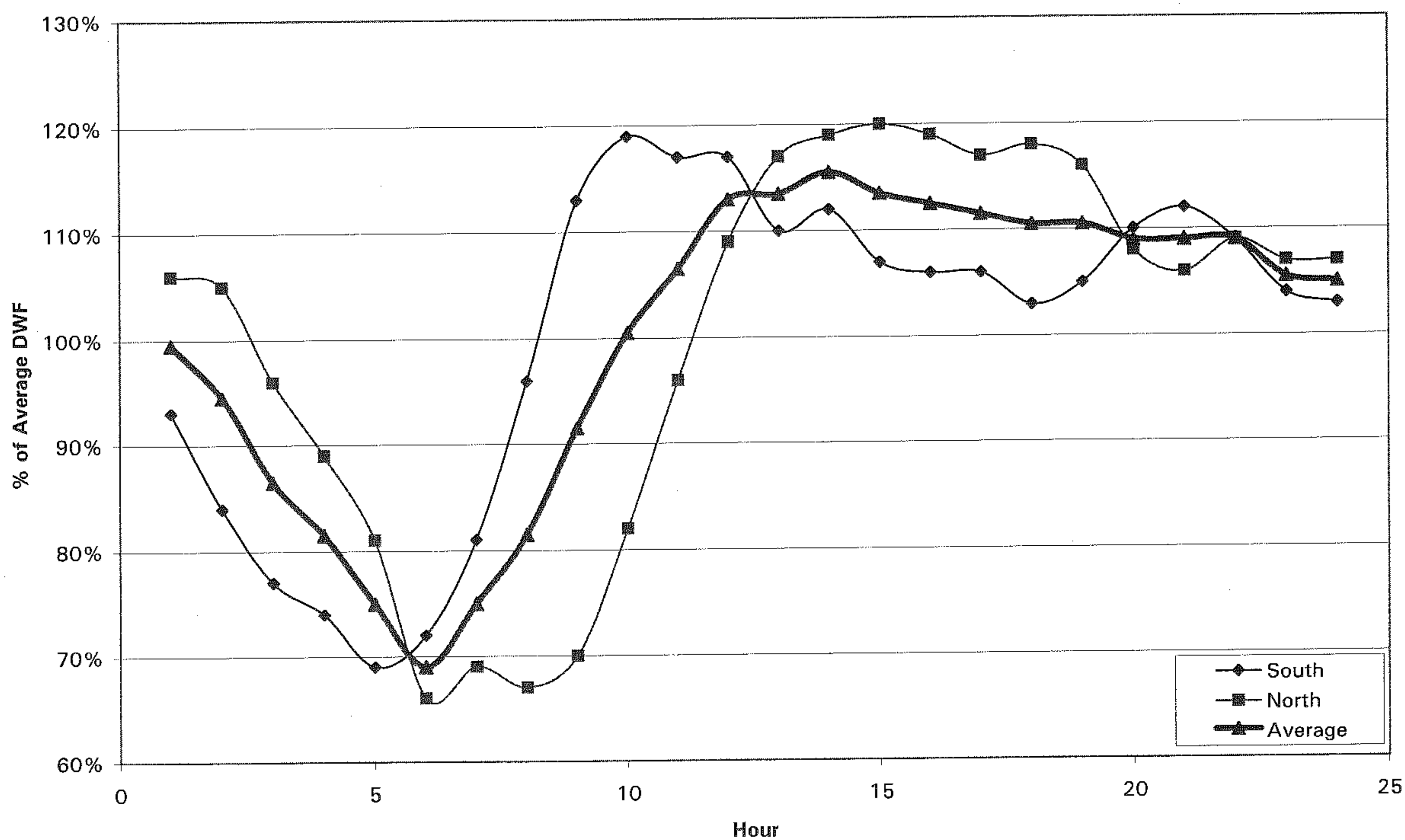
Figure 2
Relationship Between Overflow Cessation and the End of Rainfall Events





NOTES
(1) Data is from April 1, 2002 - December 30, 2004.
(2) There are 694 hours of overflow out of 22,038 total hours (3%).
(3) 38 hours of overflow that each have a unique "time since most recent rainfall" are not shown in the top figure because they occur more than 95 hours after rainfall stops.
(4) High stage is 5' above the long-term average stage (average stage = 548.5'; flood stage = 557.5').

Figure 3. Dry Weather Flow Distribution



City DWF.xls

LONG TERM CONTROL PLAN FOR THE
CITY OF ROCK ISLAND, ILLINOIS

Response to USEPA July 1, 2005 Comments on the
CSO Event Determination and First Flush Memos

Comment:

The third full paragraph on page 2 states that Figure 1 (a through k) portrays hourly rainfall depth. The actual figure appears to show daily rainfall depth. Please clarify what Figure 1 is intended to portray.

Response:

As stated in the memo and on the graph, Figure 1 does show hourly rainfall. Because the size of the graph makes showing an hourly scale impractical, the scale on the bottom of the graph is in days. Attached is a blown up portion of Figure 1a showing just June 4, 2002. On this figure you can clearly see that the rainfall data is hourly.

Comment:

Footnote 2 on page 2 states that continuous monitoring of CSOs at Outfall 001 commenced on April, 2002. Give the configuration of the headworks, how was flow from Outfall 001A measured directly?

Response:

Flow from Outfall 001A was not measured directly. As described in Combined Sewer Overflow Frequency and Duration Report (submitted to the U.S. EPA in June, 2003), there are two area-velocity flow meters measuring combined sewage flow into the Mill Street WWTP headworks. The area-velocity meters use sewage depth and velocity measurements to obtain flow rate values at the north and south interceptors. As also stated in the Frequency and Duration Report, two weirs were installed in the north and south diversion structures to decrease the number of overflow events. The weirs raised the level at which the combined sewers overflow thereby maximizing flow to the WWTP and optimizing inline storage of the combined sewage. See the attached figure for the configuration of the flow meters and weirs. When the area-velocity meters record a flow depth greater than the height of the weirs, an overflow is occurring. The flow rate of the overflow can then be calculated by subtracting the plant influent flow from the area-velocity recorded flow or by using the weir equation.

Comment:

Note 3 in Figure 2 refers to 38 hours of overflow that occur more than 95 hours after rainfall stops. Please provide a further discussion or explanation of these overflows.

Response:

The statistics shown in Figure 2 were based on the data shown in Figure 1, including rainfall data from the Pumpstation and BHLS rain gages. As shown in Figure 1b, there was a period of time between July 11, 2002 and August 6, 2002 when these two rain gages were not working properly and thus they recorded no rainfall. During this period, several overflows occurred at CSO 001. Due to the malfunction of the rain gages, the statistical analysis indicated that there had been more than 95 hours since the most recent rainfall when these overflows occurred. In reality, there was rainfall on each of the days that these overflows occurred. The table below lists the daily rainfall recorded at the Mill Street WWTP on these days.

Date	Rainfall at WWTP (in)	Hours of Overflow
7/27/2002	2.4	9
7/28/2002	1.4	1
7/29/2002	.8	21
8/4/2002	.75	2
8/5/2002	.5	4

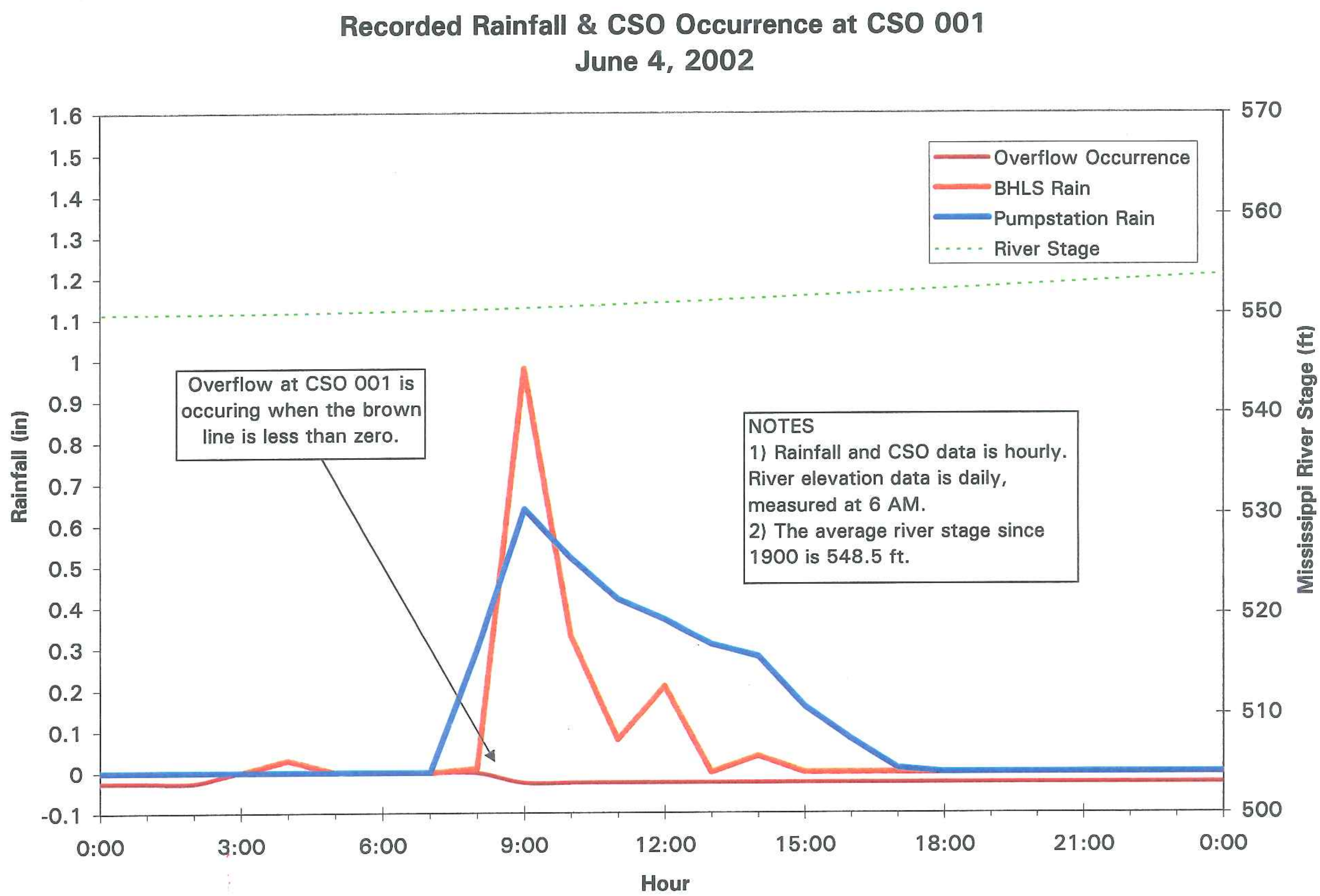
The above explanation accounts for 37 of the 38 overflow hours supposedly occurring more than 95 hours after rainfall. The remaining overflow hour to be explained occurred on August 24, 2004 at 7:00 AM. Figure 1j indicates that there was a substantial rainfall on this day. A close look at the rain gage data shows the rainfall beginning at 8:00 AM. The difference between the overflow start time and the rainfall start time can reasonably be assumed to be the result of slight monitoring inaccuracy. Thus, there were actually zero hours between this hour of overflow and the last rainfall event.

Comment:

Before continuing its review of the First Flush Memo, U.S. EPA needs an additional document. Footnote 2 on page 2 of the memo makes reference to a March, 2004 report titled "Combined Sewer Overflow Control Project E and Projects C, D, and E Additional Services, City of Rock Island, Illinois". We do not believe that U.S. EPA possesses a copy of this report. Please submit a copy to myself and Yvonne Ciccone of SAIC.

Response:

A copy of the report is attached. Copies of the report are also being sent to Yvonne Ciccone of SAIC and Tom Andryk of the Illinois Environmental Protection Agency under separate covers.



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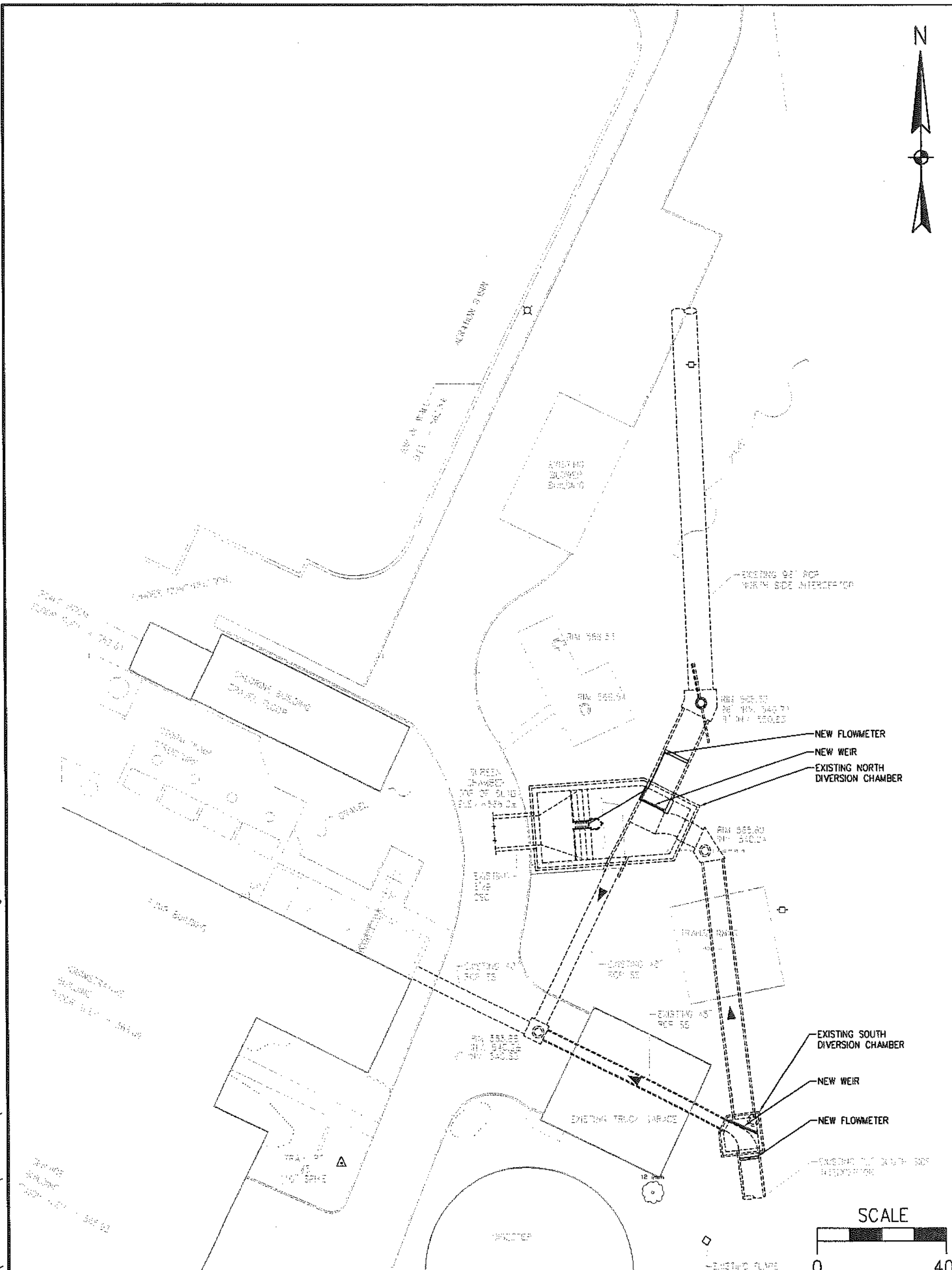

TRIAD ENGINEERING INCORPORATED	DSGN BAT	CITY of ROCK ISLAND	FIGURE 2	SHEET NO. FIGURE 2
© 2005 Triad Engineering	DR PDP	ROCK ISLAND, ILLINOIS	CSO OUTFALL 001 NORTH AND	DWG NO. 02-W001631
	CHK		SOUTH DIVERSION STRUCTURES	DATE Jul 2005
	APVD		WEIR AND FLOWMETER INSTALLATION	PROJ NO. W001631 BG013

J:\Projects\W001631\BG013\02-W001631_BG013.dwg Jul 08,2005 - 1:41pm peter.plewa